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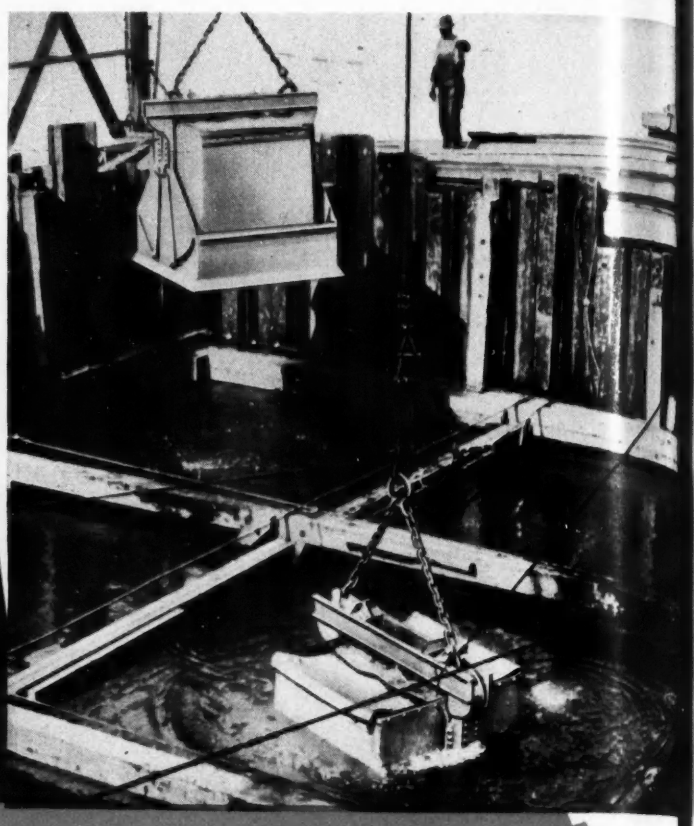

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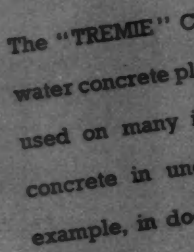

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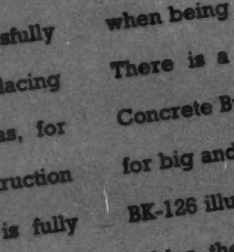

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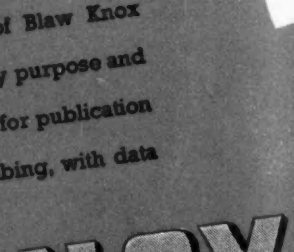

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A Seven-Day Journal

Higher Technological Education

Two years ago, the Minister of Education appointed a National Advisory Council on Education for Industry and Commerce, under the chairmanship of Lieut.-General Sir Ronald M. Weeks, to tender advice on all matters concerned with the development of education in that field from craftsmanship up to the highest levels of management. The Council's first report, which was published on Tuesday last (H.M. Stationery Office), deals with the future development of higher technological education. The main recommendations made in the report are:—The establishment or development of courses of a high standard in technology; the creation of new awards of degree standard; and the establishment of a Royal College of Technologists to approve such courses and confer the awards. The principal task of the Council has been to suggest how the contribution of the technical colleges could be improved and expanded to meet, not only the needs of industry, but also those of the individual student and, in that connection, consideration has been given to the views of no less than 145 different bodies. It is pointed out that at the present time both the universities and the technical colleges are concerned with the training of technologists, the technical colleges dealing more with students coming direct from industry. The Council agrees that the universities have a specific function to perform in the development of technological education and that their work should be more closely related to fundamental science than that of the technical colleges, their courses, in general, containing a smaller amount of training related to immediate or special work in industry. The Council thinks that, given a radical improvement in finance, equipment, staffing and accommodation, the technical colleges could and should provide more high-level courses of a degree standard and courses for post-graduate work. It is also felt that a suitable award is necessary to encourage students to undertake these advanced courses, and associateship of the suggested Royal College is recommended as the first award, membership as the second award, and fellowships and honorary fellowships for those who distinguish themselves further in technological education and research. The proposed Royal College, it is suggested, should consist of a Court, assisted by a Council and an Academic Board. The Court would consist of sixteen persons of eminence in the field of technology, nominated by the Crown, four representatives of the Council and four of the Academic Board. The Council would include persons nominated by the technical colleges, employers, employees in industry, professional institutions and education authorities, and the Academic Board would include members of the teaching staffs of technical colleges and universities and persons experienced in educational matters, selected from among professional institutions and industry.

A Diesel Electric Locomotive for British Railways

On Tuesday last we were given an opportunity to make a short journey in a train hauled by a new mixed traffic diesel-electric locomotive, which is to be used for a comprehensive series of trials by British Railways. These trials are being made to explore fully the possibilities of a locomotive of the type and power of the new unit in the operation of branch line and local train services. The trials, together with the results obtained from the diesel-electric shunting and main line locomotives already in service, will enable diesel traction to be investigated over the whole range of railway working in this country. The new locomotive is of the 0-4-4-0 (or B_o-B_o) type and is of 827 h.p. It was completed at the Glasgow works of the North British Locomotive Company, Ltd., and the British Thomson-Houston Company, Ltd., manufactured the electrical generators, traction motors and control apparatus. The sixteen-cylinder diesel engine, rated at 827 b.h.p. at 1250 r.p.m., was supplied by Davey, Paxman and Co., Ltd. The locomotive is of double bogie design and has nose-suspended traction motors mounted on each axle driving through single-reduction gearing. The general lay-out of the power equipment is similar to that of the standard 350 h.p. diesel-electric shunting locomotives which have been successfully operated for a number of years. A difference in the new locomotive lies in the provision of a carriage warming boiler in a separate compartment behind the driver's cab, and the repositioning of the main fuel tank at the front of the locomotive.

The Kelvin Gold Medal

It has been announced this week that the Kelvin Medal Award Committee has awarded the Kelvin Gold Medal for 1950 to Dr. Theodore von Karman, F.R.S., of Pasadena, California, in recognition of the eminent services he has rendered to engineering science in those branches with which Lord Kelvin was especially identified, and to commemorate which the Medal was instituted. The Kelvin Gold Medal is awarded triennially, the last award being in 1947 to Air Commodore Sir Frank Whittle, F.R.S. Other recipients of the Medal have included Dr. W. C. Unwin, F.R.S., Dr. Elihu Thomson, of the U.S.A.; Monsieur Andre Blondel, of France; and the Marchese Guglielmo Marconi. The Committee responsible for making the award consists of the Presidents of the Institution of Civil Engineers, the Institution of Mechanical Engineers, the Institution of Electrical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institution of Mining Engineers, and the Institution of Engineers and Shipbuilders in Scotland.

Completion of the Clarence Dock Power Station

To commemorate the completion of the extensions to the Clarence Dock power station, Liverpool, a stone was laid by Lord Citrine, Chairman of the British Electricity Authority, on Tuesday last, November 14th. Work on the construction of the first section began in 1929 on a site purchased from the Mersey Docks and Harbour Board by the Liverpool Corporation. This initial section consisted of two 51,250kW sets, together with four boilers of 160,000 lb per hour capacity, and four boilers of 200,000 lb per hour, the eight boilers providing a pressure and temperature at the stop valve of 450 lb per square inch and 730 deg. Fah. respectively. This section was finally commissioned in 1936 and was followed by a further section commissioned during 1938, consisting of a further two 51,500kW sets, with six boilers operating at 630 lb per square inch, and a temperature of 830 deg. Fah. Another boiler of 250,000 lb per hour capacity with one 51,500kW set, was commissioned in 1943. All these boilers were stoker fired, but in 1942 two pulverised-fuel-fired boilers were installed which became operative in 1946. The present extension consists of two 51,500kW sets and three 350,000 lb per hour capacity boilers using pulverised fuel. When this final extension is commissioned the total capacity of the station will be 360,000kW, occupying a site of only 11 acres. Speaking at the ceremony, Lord Citrine instanced many of the factors which are adversely affecting the development of the electricity supply in this country, and disclosed that a period of seven years was now required between choosing the site and the commissioning of a new power station. He stated that it was imperative to employ large high-pressure units in all new stations, and that this equipment, particularly the boilers, was very difficult to obtain in this country, and even with other equipment the delivery schedule was often behind. The cost of equipment was now four times its pre-war level, and he quoted overall plant and installation costs as being as high as £54 per kilowatt capacity.

Hull Incorporated Chamber of Commerce and Shipping

At the annual dinner, held last week, of the Hull Incorporated Chamber of Commerce and Shipping, Sir W. Guy Ropner proposed the toast, "The Transport Services," in the course of which he said that people in Britain were too complacent and did not make sufficiently strong complaints about the inadequacy of facilities in all forms of transport. Referring to shipping, Sir Guy admitted faults, but welcomed criticism, and advised concentration upon improving services instead of manufacturing excuses and defending inefficiencies. Turning to coastal shipping, he said that the industry was optimistic about the partnership between coastal shipping and the Transport Commission on the Coastal Shipping Advisory Committee and he believed that Lord Hurcomb would not allow theoretical planners to ignore the years of experience of shipowners and the value of local initiative. In his reply, Lord Hurcomb agreed to the soundness of all sections of the trade bearing a proportion of the expenditure in providing transport, but said that he did not agree that the deficit incurred was the outcome of policy of the British Transport Commission. He maintained that a favourable balance of £31,000,000 remained after meeting all expenses, but this was turned into a deficit of £20,000,000 after paying interests on borrowings and providing for capital redemption and other items charged against revenue. Despite internal and external pressure and an atmosphere of controversy, Lord Hurcomb expressed himself confident that when the recasting of inland transport was complete a better financial showing would be made. He asked that the services should be given a fair trial without prejudice and stated that only by maintaining and improving the load factor would charges be limited or reduced.

International Conference on Wind Power

An international conference of experts to discuss various aspects of wind power was held in London last week. The conference is the outcome of a recommendation from the Council of the Organisation for European Economic Co-operation. Representatives from Austria, Belgium, Denmark, Eire, France, Germany, Greece, Holland and Italy, as well as delegates from the United Kingdom, the Commonwealth countries, and from the U.S. Economic Co-operation Administration were present. The business of the conference has been to study the technical and economic aspects of wind power as applied to the generation of electricity, and it has been comparing experiences in the research and development work now being undertaken. The group of experts attending this conference held a meeting in Paris last April, when it was decided that in each of the interested countries a particular organisation should be designated to co-ordinate studies in wind power. In this country the British Electrical and Allied Industries Research Association is fulfilling that function.

The Esquimalt and Nanaimo Railway

By EDWARD H. LIVESAY

No. II—(*Continued from page 426, November 10th*)

THERE is only one passenger train a day in each direction on the E. and N.R., which is chiefly a freight line, so if you are going to Courtenay, the northern terminus, from Victoria, you will travel on train No. 1, in these post-war days, leaving at 10.30 a.m. If you are going in the cab you will find your engine to be one of the "D10" class, 4–6–0 (or you would have done had you made your trip a year or so ago. Diesel locomotives began to take over from steam in 1949 on the E. and N.R., and will soon be supplying all the tractive power required, a striking sign of modern trends bearing in mind that the railway was built on coal and for coal haulage, that the plentiful supplies of coal still in the ground are a diminishing asset and that there is no oil on the island, at any rate, in production yet. The diesels will be dealt with later in this article, which is the swan song of steam). On the occasion I am describing the steam locomotive was No. 907; the outline drawing, photograph and the following dimensions give all the necessary information about it.

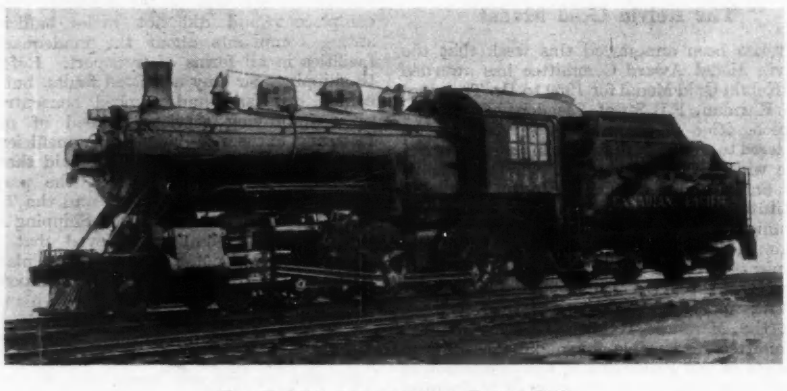


FIG. 7–4-6-0 LOCOMOTIVE, E. AND N.R.

Cylinders	21in by 28in
Driving wheels	5ft 3in
Tractive force	33,400 lb
Boiler diameters	5ft 10in and 6ft 5in
Tube length and diameters	14ft 3in and 2in
Heating surface:	
Tubes and flues	2,229 square feet
Arch tubes	29 square feet
Firebox	180 square feet
Superheater	408 square feet
Total	2,846 square feet
Grate area	49 square feet
Steam pressure	200 lb
Weight on drivers	70 tons
Weight of engine	91¼ tons

Walschaert's valve gear, rebuilt from earlier design, with superheater, oil-firing, &c. are embodied in this simple, sturdy engine that has done much useful work elsewhere on the C.P.R. before increasing demands relegated it to the E. and N.R., where it is still capable of meeting all calls made upon it until it gives place to diesel power. These old engines are somewhat typical of much E. and N.R. equipment, which often consists of "left-overs" from other parts of the system. Time was when the E. and N.R. was known as "Canada's second-hand railway," but that was before the war put it—and incidentally the whole of Canada—right back on its economic feet after ten years of "depression," a fact that is apt to be played down in many quarters. Canada did exceedingly well out of the war and so did the E. and N.R.; in 1939 both were in very poor shape.

Train No. 1 consisted of eight cars, nearly double the normal load; one box-car, three mail-baggage and four passenger, the weight being about 450 tons. The cab-complement totalled four: enginemen Wensley and Somerville (the former originally from Moreton, Yorkshire), master mechanic Sturrock, and the writer. Mr. Sturrock is a grand-nephew of Archibald Sturrock of the old Great Northern Railway, whose 7ft 6in single and steam-tender goods engines, both ahead of their time, the mid-1800s, are still a part of locomotive history, and not forgotten. Locomotives are evidently in the blood of the Sturrocks. It was a perfect day, of the kind residents like to term "typically Victorian"; of warmth and sunshine tempered by a gentle breeze off the Pacific, the waters of the harbour glittering in the morning sun, the dome of the beautiful Parliament building standing out against blue sky and the snow-capped Olympics across the Strait of Juan de Fuca. After "marrying" the two halves of the train it pulled out at 10.35, 20 min late, crossing first the bascule and immediately after the steel bridge over the road to Esquimalt; there is, I think, only one other "over-road" bridge in the whole 140-mile length of the line to Courtenay, which makes evident how prevalent level-crossings still are in Canada. Passing the nearby shops and roundhouse, we stopped at Russells, the original terminus; the shops are well-equipped and during hostilities undertook considerable war-work in addition to necessary repairs on the twenty-four engines that handled all the traffic on the line before the advent of the diesels in 1949. A number of logging-cars were also built, running on two standard four-wheel trucks, connected by a heavy squared timber reach, with bolsters to carry 50ft logs, the writer doing considerable work on them as a humble contribution to the war effort in 1943. Leaving Russells, the main road to Esquimalt is crossed with the help of the only gate protection I remember on the line; a flimsy wooden bar rising vertically to open and dropping across the road when a train is due, the usual arrangement in N. America—quite useless to keep vehicles off the track even at slow speed—one might as well hold out a walking-stick. However, I suppose nothing will keep back a fool driver who is determined to gate-crash—only the guillotine.

Carrying on through the suburbs, past whole streets of warehousing, particularly in Esquimalt; neat little four-room wooden bungalows, each in its own lot, standing where only a year or so before there had been nothing but fields and bush, the next stop was at Admirals Road—originally built by the Navy, I believe, nearly a century ago, through the bush to the hospital that formed some of the very first erections that ultimately expanded into the Esquimalt Naval Base; the Navy had a lot to do with the settlement of Vancouver Island—beside the Naval Barracks, H.M.C.S. "Naden," and the Dominion dry dock, 1186ft by 135ft by 40ft, in which the "Queen Elizabeth" was fitted up as a transport in 1942. A number of Naval ratings were picked up *en route* to the training camp at Comox, they and their impedimenta being responsible for two cars of the unusually heavy train. There is a fine, sweeping view out over Esquimalt Harbour from just beyond Admirals Road, over what was formerly Yarrow's No. 2 yard, now utilised by a lumber company, the track following round the shore for a mile or two, with spurs to the dock and a C.P.R. wharf and oil tanks. Near Palmers, 5 miles from the start, the track crosses the C.N.R. line to Youbou on Shawnigan Lake; then comes a very heavy grade, Fagan Hill, 2 miles of 1 in 63, the first real climb on the line, which No. 907 took steadily enough with wide throttle, opportunity being taken to feed sand through the firedoor and clean oily deposits from the flues. The speed dropped to 15 m.p.h., Wensley remarking: "A couple more cars would be about all she could handle." I saw no reason to query this.

It is lovely country here; the sun poured down over the dark green firs and yellow broom, the seeds of which were, I believe brought out from Scotland with much the same result that followed the introduction of rabbits to Australia—the intention was good but the stuff has become a plague, spreading everywhere round Victoria and creeping farther and farther afield, invading farmlands and climbing mountains; very lovely but an agricultural nuisance. Nesting among all this clean green and gold were little white houses, red or green-roofed, generally flower-decked, giving a Swiss aspect to the countryside, a similarity strengthened by the snow-capped Olympics lying all along the southern sky line across the Strait of Juan de Fuca. After reaching the top of the stiff Fagan climb at Langford, a mile or two of level followed, serving as a "breather"; we were already 245ft up from sea-level at Victoria, 8 miles back, and nearing Goldstream, with its history and memories of the brief gold rush about mid-century, when it was discovered that "there was gold in that thar creek!" There was, but not very much and the rush soon petered out, leaving scarcely a wrack behind but the melancholy, mouldering remains of Leechtown. Then began the 10-mile Malahat Bank, the E. and N.R.'s Shap, with its almost continuous 1 in 65 gradient, and maximum about halfway up, between Niagara and Arbutus Canyons, of 1 in 52. This is by far the heaviest pull on the main line, showing there may have been some excuse for early opponents of the railway claiming it could not be taken over the Malahat Range. It could, but only just,

and it adds very considerably to the expense of operating the railway, which still has relics of its primitive past, such as a trestle bridge near Langford, and several others traversed subsequently.

Goldstream, a "flag" stop, 11.08, found us well on the big hill, and 280ft up. The scenery had been getting continually finer and more inspiring, and finally it became too tempting—I left the cab and clambered along forrard to the cowcatcher, from which I could see all there was to be seen—and this was plenty. I was all the more inclined to seek this vantage-point as there was no spare seat in the cab; nothing but a draughty eyrie on the tender oil-fuel tank, giving a fine lookahead right over the roof of the cab, granted, but squarely in the slip and smut-stream and therefore both primitive and dirty. The pilot (Anglice: cowcatcher) has none of these drawbacks, so to it I went, with Sturrock's warning in my ears: "Do as you like, but don't blame us if we hit a cow!" I promised not to, a safe assurance—there are no farms up the Malahat, and probably no cows—only bears, deer and cougars. We were really in the wilds now, with glorious mountain scenery spread out in every direction. No. 907 climbed steadily at 10–15 m.p.h., her staccato exhaust banging away overhead, echoing back and forth at times from the walls of rock cuttings, where broom and ferns waved from every crevice. My thoughts went back to the West Highland line between Fort William and Mallaig; there seemed parallels, except the weather—here it was lovely—there it was beastly. The gradient proved not absolutely continuous; at rare intervals there were a few yards of level; even a downward dip, noticeable at once from my nearly ground-level seat; little "rest-and-be-thankfuls," for which No. 907 was doubtless grateful, but not long enough to enable her to pick up speed. Curvature was incessant and the riding roughish, though naturally better at the front end than in the cab. It is difficult to do justice to such a trip as this, through fine scenery and in perfect weather. One needs the pen of a Ruskin—but not his inhibitions—he hated railways, did he not? Strange man; he should have negotiated the Malahat on the pilot—that would have cured him.

Still climbing, the train continued on through the dark green fir-clad mountains, the warm, pine-scented air fanning past and sunshine pouring down into the deep land-locked gorge and cool waters of lovely Finlayson Arm on one side, while on the other, the left, the Malahat Range stood out against the blue, shimmering in the summer haze. Mount Finlayson, 3000ft, the highest peak near Victoria, seemed to rise right out of the mirror-like surface of the inlet; the Island Highway, the only road from Victoria to Nanaimo and other up-island points, wound along on a shelf above the Arm, up and down, in and out, among the firs, with cars and buses spinning along it. This road has evolved from the old pack trail that preceded the railway; it is constantly being improved at great cost and is very different from the rough wagon road over which I bumped on a motor-cycle thirty years ago, almost at risk of life and limb. At 14 miles we rumbled over Niagara Canyon on a fine single-arch steel bridge, with Goldstream at this time of year a mere trickle at the bottom. This bridge, 260ft high and 530ft long, began its career spanning the Fraser River and Canyon in 1884, at Cisco, on the C.P.R. main line, until the increasing weight of the trains made heavier construction necessary; it was dismantled and re-erected at Niagara Canyon in 1912. At 500ft up, approaching Arbutus Canyon and the halfway mark, the gradient stiffened to 1 in 52, the heaviest part of the climb. There was another steel bridge here, spanning rock-strewn cleft, few of these canyons containing water-courses in summer, but in winter raging torrents pour through them to the sea, the climate of the southern part of Vancouver Island being one of extremes of rainfall—none in summer and too much in winter. Agriculturally, of course, this is a drawback; farther up the island the moisture is more evenly distributed. On the west coast it is also evenly distributed—it rains all the time—the natives have web feet.

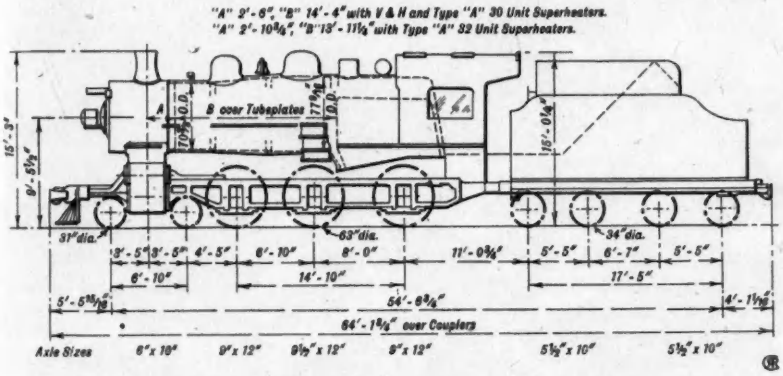

"A" 2'-6", "B" 14'-4" with V & H and Type "A" 30 Unit Superheaters.
"A" 2'-10¾", "B" 13'-11⅞" with Type "A" 32 Unit Superheaters.
B over Tubeplates
63" dia.
34" dia.
54'-0¾"
64'-1⅝" over Couplers
Axle Sizes

FIG. 8—GENERAL ARRANGEMENT DIAGRAM OF 4-6-0 LOCO

Higher yet, with the speed down to 10 m.p.h., No. 907 forged ahead to the summit. At 17 miles the track dipped sharply for a few hundred yards, and the speed rose to thirty, but the spurt was short-lived, the gradient reasserting itself with 1 in 67; the exhaust again became harsh and staccato. Collar-work continued right to the summit, 916ft, reached through a little tunnel, unlined and 100ft or so in length, the engine still pulling hard and the exhaust hitting the roof with a bang that made my ears ring. Shades of "King William III" at Dainton! With another twinge of home-sickness I pictured the sort of job she would have made of the Malahat. Immediately after we came to a halt at Malahat; nothing but a board, if I remember rightly, beside a water tank of the standard 20,000 gallon capacity, with a perfectly divine view in nearly every direction. Time, 11.35, 20 miles in one hour, including four stops, plus a 900ft rise; really very creditable with a 450-ton load. Up here we were in a world still much as nature made it, but looking down certain man-conceived improvements were visible—the Island Highway with cars spinning along it; white cottages shining in the sun in little clearings on the shore of placid Saanich Inlet, into which Finlayson Arm opens; a little boat moving like a beetle across its mirror-smooth surface, leaving a "V" in its wake. It was all utterly lovely as you will agree when you make the trip on the E. and N.R., but remember—it can only be enjoyed to the full from the cowcatcher. My thoughts went back to another climb I have made several times in the cab, up which I had watched, fascinated, engines fighting their way to the summit—Shap. Isn't that something over 900ft, too? Consulting my grimy gradient-book, over which, expatriated *pro tem*, I sometimes pore, Shap seems easier than the Malahat. The latter raises a train 700ft in 10¼ miles with incessant curvature; the former covers three times the distance in bringing a train to much the same altitude over gently aligned, perfect track, only the last 4 miles being really stiff, 1 in 75.

By this time I had begun to form opinions of the engine; they were very favourable. A simple, rugged job, handling its heavy load on formidable gradients without objection, the ample adhesive weight making slipping unnoticeable. Steam pressure was well maintained, thanks to oil-firing and ample boiler-power; and blowing-off—again thanks to oil-fuel and its ease of regulation—was a very minor matter, however sudden the cessation of demand, skilfully anticipated by Somerville as it generally was. The more I see of oil-firing the more I like it; it is a pity nature did not arrange greater reserves of liquid fuel in Britain. But to continue: the regulator was of the old-fashioned, "pull-out" type, with the throttle in the dome and the reverse ("Johnson-bar" in the vernacular—don't ask me why) was manually operated. There was no feed-water heater nor exhaust injector, neither of these amenities being popular when No. 907

FIG. 9—MASTER-MECHANIC ARCHIBALD STURROCK

was rebuilt into her present shape—incidentally the C.P.R. does not favour the former auxiliary on any of its engines—it is a C.N.R. speciality—both injectors being live steam. The riding was roughish, but undoubtedly much of this was due to the track, which, previous to the war, had been allowed to deteriorate somewhat in anticipation of the possibility that the whole line would be closed down. When the war came along and revived the lumber industry—and, of course, every other activity on the island, too—this counsel of despair was shelved, but the building up and repair of the permanent way still did

not get the attention it deserved, due to shortage of labour and material, the heavy wartime traffic doubtless adding to the trackmen's troubles.

Getting away from the Malahat stop, a long 8-mile drop to Shawnigan Lake began; the engine and all the occupants of the cab relaxed. The hardest part of the whole run to Courtenay was behind, so with throttle generally shut and vacuum-valves sniffing, No. 907 drifted down through country beginning to open out a little, with the C.N.R. coming into sight on our left and the great, placid sheet of water, Shawnigan Lake, showing occasionally through the all-pervading firs. Cliffside, 25 miles, was passed non-stop, where in 1886 Sir John Macdonald drove the spike at the opening ceremony. Mail was picked up from a "gallows" here; I have never noticed mail being dropped in Canada with the help of this apparatus; it is merely thrown off; if it gets under the wheels—well, its just too bad for the mail, I suppose, and that's all about it. The Shawnigan stop was made at 11.48 and was longer than usual; the station is right alongside the lake, with the hotel adjoining—Shawnigan is quite a summer resort—and the water almost laps the metals, making this an obvious place for a water-tank; a supply was duly picked up. The train pulled out at 12 noon, now 42 min late, but it will be remembered the Victoria start had been late, too, 20 min; "flag" stops and the extra heavy load were responsible for the additional time squandered. So excuses can be made for No. 907; in any event, time is of minor importance on the E. and N.R.; "the view, the view's the thing, wherein you'll catch the spirit of the isle!" Look at the scenery, and not at your watch.

1. E. and N.R.
2. Admirals Road Station.
3. Government dry dock.
4. Ex-Yarrow's No. 2 Yard.
5. Esquimalt Harbour—"the place of shoaling water" (Indian).
6. C.P.R. wharf and spur.
7. Island Highway.
8. Craigflower farm. The oldest standing building on the island, built in the '40s of the last century.
9. C.N.R.
10. Portage Inlet—inner end of Victoria Harbour.
11. Parsons Bridge, near Palmers.
12. Fagan Hill.
13. Langford.
14. Malahat incline and range.
15. Mount Finlayson.
16. Goldstream Lake.
17. Sooke Harbour.
18. The lagoon.
19. "Hatley Park" (ex-Dunsmuir mansion, now H.M.C.S. "Royal Roads").
20. Strait of Juan de Fuca.
21. Olympic Mountains.

FIG. 10—ESQUIMALT—MALAHAT, E. AND N.R.

From Shawnigan on the prevailing trend is downward though the profile is saw-tooth; at Duncan, 39·7 miles, we are almost down to sea-level again. Duncan is a prosperous little town, the centre of a considerable farming community, where many retired naval and military people have settled. "Gentleman farmers," in fact; the kind that takes 25 cents-worth of eggs to market in the Canadian equivalent of a Rolls-Royce, complaining the while that "there's no money in farming." (Nothing derogatory is intended by this, the inference merely being that people who do not have to make a success of farming seldom do so, particularly Service officers, at any rate, in Canada; they have neither the essential knowledge of the business nor the singleness of purpose necessary for a happy issue out of all a farmer's afflictions. These endowments are generally only acquired over a lengthy period, beginning in youth, with necessity acting as a spur. Never begin farming late in life—even at Duncan!)

Time, 12.28: 39·7 miles in 113 min; 21 m.p.h., with eight stops. Away again on a falling gradient, the next thing worth noting was a heavy 3-mile bank up through Somenos, and Hayward Junction, where the Cowichan Lake branch leaves the main line, running west for 19 miles to timber-limits and a big mill on the lake. On this branch, at Summit, near Sahtlam, about halfway, the track reaches an altitude of 692ft, a rise of over 600ft in 9 miles, nearly 4 miles of this being at 1 in 50. I believe a big Shay articulated locomotive works into Mayo, the next station to Sahtlam, which I intend to examine some day. Leaving Hayward Junction, the main line drops to Osborne Bay Junction, mile 47·5, only 29ft above sea-level, where a branch goes off to a jetty at Osborne Bay, so it will be seen we are now nearly down to water-level again, as at Victoria, after having climbed to an altitude of over 900ft *en route*. There are several of these little spurs leaving the main line, built mostly for lumber purposes, not appearing in the time-table, and no passenger trains run over them. Vancouver Island's top-ranking industry is lumber; without it the island would never have amounted to very

much and the E. and N.R. would probably long ago have ceased operation.

At Chemainus, 51 miles, the great mill of the Victoria Lumber Company stands beside the track, one of the largest and most up-to-date in the world probably, the direct descendant of the original little water-powered mill built by the pioneer, Askew, in 1862. Farther along, 7 miles, is Ladysmith, the town that several times has nearly died yet, when at its last gasp, rose from the cold slag of its smelters

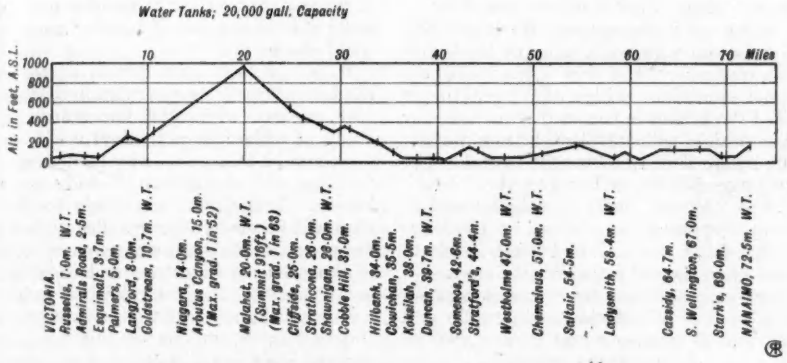


FIG. 11—PROFILE OF GRADIENTS, VICTORIA—NANAIMO

and the ashes of its pits to become a prosperous lumber town, which shows clearly how insecure are the fortunes of a community dependent on one industry for its existence. Ladysmith has a checkered story of ups and downs. Founded by Dunsmuir in 1897, when this pioneer was in the heyday of his coal-mining career, a shipping wharf was built at Oyster Bay, nearby, to handle the coal from the newly-opened mines at Extension, a little to the north of the town, the original mines at South Wellington, which also shipped their output from this wharf, having shown signs of petering out. The Boer War and the relief of Ladysmith suggested the name to Dunsmuir; it would be more appropriate if it were rechristened Phœnix. In 1910 it was prosperous, the Extension mines still being in full production, 600 men travelling back and forth daily between the town and the mines. But the stars in their courses fought against Ladysmith; the Wellington mines ceased production, a disastrous two-year strike hit the town hard in 1912, the increasing use of oil-fuel reduced the demand for coal, and when finally, in 1931, the Extension mines shut down, it seemed that the doom of Ladysmith was sounded. It was dying on its feet and continued to do so until recently, when new life was injected into the shrivelling veins by the Comox Logging and Railway Company moving into the district to exploit adjacent timber-limits, acquiring foreshore rights, building trunk roads, and so forth. Now Ladysmith is on the upgrade again, climbing once more to prosperity—until the timber is worked out! Then what? I do not know, and neither do the residents; they are optimistic at present; as to the future, the remote post-timber future, Micawber-like, they are confident that nothing will occur to sully its virgin page and that—in short, that something of an extraordinary nature will always turn up in time to save their fair city from extinction. Modern transport may do much to give the town permanency in any case; people build houses there now, though they may work far away in the surrounding country, going to their jobs by bus and car; that is the modern trend that has helped many another town and may save Ladysmith. It is no longer necessary to live next door to one's job in these days of rapid transit. Meanwhile, things are going well with Ladysmith. The war and its aftermath have given the town a shot in the arm; old houses are being repaired and new ones built; stores are being modernised, roads improved and so on, and altogether Ladysmith looks very different from the dingy, dilapidated, depressing dump I remember a few years back, before the world erupted in 1939. The future? "Pshaw! Ours not to see the distant view; one step enough for us!"

South Wellington, the next stop of importance, exhibits the unusual juxtaposition of pretty country, green fields and slacks piles, but only, I take it, because the mines are no longer being worked. There are large untapped coalfields here, but *cui bono*—what is the future of coal? Dubious; I would not care to invest my hard-earned dollars in Vancouver Island mines! To some extent I imagine the miners themselves were responsible for the decline of the industry, by continually demanding higher wages until consumers could no longer afford to use coal, switching perforce to oil. This was, I believe, the case with the C.P.R.; further, many a housewife in B.C. is installing oil-burning kitchen ranges rather than pay the soaring prices of coal, with its accompanying dirt and smoke. The miners always seem to get their demands—but ultimately find they have no jobs. Many "workers"—here at any rate—are under the delusion that the primary object of industry is to provide them with employment and on their terms. It is not—it is to provide goods or services. The shipyard workers here have had the same delusion; now there is next to no shipbuilding, in which B.C. cannot compete with the East, or still less with Britain. The only time shipbuilding thrives here is during a war, when cost doesn't matter—nor workmanship either!

After leaving Ladysmith the gradients are comparatively easy, averaging about 1 in 100 for the next 25 miles until nearing Nanaimo, when there comes a mile or so of rise at 1 in 63, followed by a downward dip at the same figure into the station, which lies 125ft above sea level; it is not at the waterside. The country is pretty hereabout, with some clearing, greenwoods and many a glimpse of mountain and sea, through which No. 907 ambled at 35–40 m.p.h., the crew with nothing to bother about save to look out for fools "beating the train to the crossings," which are fairly common in this older settled district. Wensley had collided with one of these idiots just outside Nanaimo only a few days before, beating him to the crossing; the said idiot ended up in hospital and his car on the scrap pile. I, the observer, was also having a peaceful time observing—from the tender oil-tank over this section, a fine vantage-point, though, as I have said, smutty—I prefer the "pilot." Slowings for pit-subsidences sent my thoughts back to trips on the "Coronation Scot" and other trains of that ilk, when our flight was interfered with at Polesworth and nearing Glasgow by similar subterranean obstructions; all the more likely to cause trouble on Vancouver Island because the workings are so much nearer the surface. And so train No. 1 rolled to a stop in Nanaimo, the halfway point, at 2.15 p.m., 30 min late; 72·5 miles in 220 min, after about a score of stops, average speed 19·7 m.p.h. Nothing spectacular, but creditable, bearing in mind conditions, engineering and scenic. Why grudge the fleeting minutes as they pile up when riding the E. and N.R.? Look at the scenery and be happy!

(To be continued)

A Review of Road Problems*

By W. H. GLANVILLE, C.B.E., D.Sc. (Eng.), Ph.D.

No. II—*(Continued from page 433, November 10th.)*

SOME PLANNING CONSIDERATIONS

ALTHOUGH the forecasting of traffic trends, whether national, regional or urban, is a major problem in itself, it is no more than the beginning of a whole series of problems to the engineer who wishes to evolve a national road system. In a theoretical approach to road engineering the process which comes first in the engineer's mind is the drawing up of a road plan which satisfies the various traffic potentials, the roads at this stage being conceived as no more than a series of lines on a map. At this distance in time it is easy to see that the existence of a road system which was, in effect, no more than a legacy of the coaching era, should not have deterred our predecessors from adopting, right at the beginning, a similar approach to British road development. But who then could have guessed the tremendous growth or the lengthening range of road transport?

Subsequent road history has been a prolonged attempt to atone for this original lack of foresight. However, we can take some encouragement from evidence over the past two decades of a change of outlook. Since 1933 two Trunk Road Acts have been passed which have placed about 8000 miles of main road under central control and finance, and there have been progressive extensions of the system of classification. The Ribbon Development Act and, later, the Town and Country Planning Acts, have given road authorities the means to prevent the strangulation of arteries and—most recent and perhaps the

* Presidential Address, Institution of Civil Engineers, November 7th. Abstracts.

most significant of all—the Special Roads Act has been passed and motorways have been adopted as part of the official road policy. A recommendation that at least one motorway should be constructed as an experiment was, in fact, put forward by the Alness Committee in 1938. We have still to see this implemented, although plans have been prepared.

At the same time we should not lose sight of the fact that motorways in rural areas can have only a limited effect upon the congestion in the streets of our big cities. When the conception of the ring road became popular it was thought that it contained the solution of many of the city traffic problems, but both in Great Britain and in the United States the limitations of the ring road are now becoming apparent.

Operational Research

Although progress in reforming the British road system has been lamentably slow, it is incumbent upon us as engineers to proceed on the assumption that the time will come for an attempt to be made on a scale exceeding everything seen in the past.

There is probably no branch of technical activity in which opinion based upon casual observation and experience and backed up by specious argument has played a greater part than in the development of the roads of the country. The approach of those who advocate the use of "operational" research in industry (i.e., that, in reaching decisions, a more conscious effort should be made to determine the underlying facts and to submit theories to statistical and mathematical examination) is, of course, not a new one, but the help which observation and analysis can give in reaching the best solution to a problem has not always been realised.

A typical example is in the history of pedestrian crossings. So far as I am aware, when the Belisha pedestrian crossing was introduced in 1934 no attempt was made to assess its effect by systematically observing and recording pedestrian and vehicle behaviour; other changes were made at the same time, and it was impossible to be sure that the crossings were of value. On the other hand, the new "zebra" markings have been subjected to a searching and widespread examination. Pedestrian and vehicle behaviour have been observed both before and after marking the crossings, accident records have been kept, and it has been possible to make an accurate assessment of the probable effects before deciding to introduce them on a national scale.

Other examples are to be found in the systematic investigation of the effects of one-way traffic schemes, of the effect of changing parking regulations, of the effect of traffic patrols and of propaganda. In the course of time research of this character will fill in many gaps in our knowledge of the functional side of road design.

The Human Element

The highway problem is above all a problem concerning the human being. Human problems join hands at every point with the statics and dynamics of the construction and use of highways. The road, the driver, and the vehicle are inseparable parts of one problem. Decisions about the course he will take are made by the driver on the basis of what he sees and hears as the vehicle proceeds and, therefore, on the stimuli in the way of signs and directions that the engineer provides, and on the road lay-out, and on the road surface. The driver's decisions must be converted into changes in motion of the vehicle by means of controls. How the conversion is made depends upon his personal qualities, the lay-out of controls, the response of the vehicle, and the interaction of the tyre and the road surface.

We are learning more about the importance of these factors as the results of research become available, and some of the information is, to say the least, astonishing. It is difficult to realise, for example, that the reaction times of different drivers to a given stimulus under ordinary driving conditions may be anything from a fifth of a second to as much as one and three-fifths second; that a "slow-witted" driver travelling at 40 m.p.h. will be carried forward 100ft before he can even begin to apply his brakes in an emergency, and that if his brakes are in poor condition—within the worst 10 per cent of the brakes in use on the roads to-day—the vehicle will travel at least a further 180ft before it can be brought to rest. The very large differences between the "best" and the "worst," both in vehicles and in human responses, are indeed a challenge which, I think, we shall find it impossible to ignore when the full facts are available.

There are perplexing discrepancies between the behaviour of individuals in traffic and their normal behaviour and it may well be that a knowledge of the reasons for these differences will have an important bearing on road safety.

The human element clearly enters into all road accidents, and there can be no doubt that if we could by some means perfect the actions of the human being, even with our roads as they are to-day the numbers of accidents could be reduced considerably. Propaganda and education based on sound scientific knowledge can go a long way, but none of us will imagine that we can eliminate all human failings and lapses. The problem of the engineer, therefore, will always be to build roads which will allow for the fact that we are human, will permit the free flow of traffic, and will then be accident-free.

Traffic Flow

In addition to understanding the behaviour of the single unit, vehicle plus driver, the engineer must study the interaction of such units upon each other when travelling in numbers in the confined space of the highway. These laws of traffic flow are of great importance to the engineer in predicting the effect of changes in, for example, street lay-out, junction conditions, and the volume of traffic.

When questions of traffic flow in their modern form first attracted attention it became a common practice to calculate the capacity of a road from estimates and measurements showing how closely behind each other vehicles in a single line could travel over a range of speeds. To-day, we are thinking on rather different lines. It is realised that such matters as the manœuvres of drivers in passing and overtaking; the effect of vehicles parked on the carriageway in producing accidents and reducing free flow; the effect of mixed traffic; the widths of traffic lanes; the effect of providing stopping places off the carriageway in the form of lay-bys or continuous shoulders at the sides of the roads, and the spacing and design of road junctions, are generally of greater importance in determining the safe traffic capacity of a road than is the maximum number of vehicles that can be accommodated. The underlying principle is freedom of flow.

Much more would be possible, I think, if the effects of one-way streets and other devices were better understood. With this aim traffic studies were begun by the Road Research Laboratory in 1947 in co-operation with the London Traffic Working Party of the Ministry of Transport. These investigations have yielded a great deal of useful information on traffic flow. Various methods were tried, including aerial surveys, but the most valuable technique, and the most economical in manpower, consisted in filtering observation cars into the traffic and recording times and counting opposing traffic. By recording the widths of the streets it was possible to relate the total traffic flow to the running speed and to predict the effect of changes in street width. The effect of future increases in the number of vehicles using the streets and of parking restrictions could also be predicted.

It is not sufficient, however, to study the laws of traffic flow in relation to a certain road lay-out. Of equal importance is the study of where the individual wishes to go, the route he takes, and why he does so—the "origin and destination" study as it is known. This provides a guide to the use that will be made of new highway facilities, but the complete picture requires an estimate of the needs of industries and of industrial areas, and of the interplay of industrial needs and the needs of the private motorist. Detailed investigations of this kind, on a regional basis, are likely to play an increasing part in determining road development.

In his 1933 address Sir Henry Maybury suggested that chief engineers should seriously consider the advisability of including in their organisations traffic branches staffed by engineers. In the United States "traffic engineering" is now accepted as a branch of civil engineering, and a large part of my discourse this evening is covered by that term. Interest and activity have been steadily growing in Great Britain. With twice the traffic, and road accidents increasing, and with our growing knowledge of the laws of traffic flow and of the factors associated with accidents, the need for traffic experts to apply this knowledge is clearly greater than ever.

Accidents

It is noteworthy that up to 1930 the number of road accidents had increased year by year, but that afterwards the annual steady rise came to an end, the casualties remaining fairly constant until the outbreak of war. Since the war the figures have been influenced by petrol restrictions; there has recently been a pronounced upward trend, but they are still below the pre-war level.

The reasons for the improvement in the 'thirties are unfortunately not clear. The introduction of the 30 m.p.h. speed limit and of pedestrian crossings in built-up areas, the growing use of traffic lights and roundabouts, and the improvements in grading, sight lines and road markings may each have had a beneficial effect. It is possible that the mounting toll of accidents stirred the public conscience to the point at which imponderable forces came into play. We cannot tell. Even now it is a sobering thought that, if conditions remain as they are, one in five of us will be injured in our lifetime. If accidents grow with traffic it may be one in three, or worse.

In 1939 the Select Committee of the House of Lords (the Alness Committee), after carefully sifting a large volume of evidence, submitted a report on road accidents. The report was noteworthy for its thoroughness and for the number and quality of the recommendations made on every aspect of the subject. The Committee concluded that the most important factors were the education of all road users in road behaviour and the segregation of road users—motorists, cyclists and pedestrians. The report was largely

endorsed by the Road Safety Committee subsequently set up by the Minister of Transport, but financial stringency has meant that, apart from intensified propaganda and the education of children, most of the recommendations still remain to be carried out.

One recommendation of the Alness Committee was that a Road Safety Research Board should be set up and should conduct research. The outcome was the extension, in 1946, of the terms of reference of the Road Research Board of the Department of Scientific and Industrial Research to cover these matters, and later the setting up of the Traffic and Safety Division of the Road Research Laboratory.

Although each accident has its individual characteristics, in the statistical sense accidents obey laws and the chance of an accident happening depends upon traffic conditions and upon the road design. Each element of a road may be said to have its particular "accident potential." Studies of "accident potential" are proceeding, but information is slow to accumulate because, although the total number of road accidents is appallingly high, the number to be associated with any particular set of road and traffic conditions is small. Nevertheless, considerable progress is being made, and figures are being collected from police records and by "before and after" studies of the effect of road improvements. The pioneer work of Bennett in Oxfordshire in studying the effect of changes in junction design has done more than anything to focus attention on the reduction obtainable in the number of accidents by comparatively simple alterations in lay-out.

In recent years the question of accident causation has been debated at length and it is now generally agreed that to assign a primary cause to a road accident can be very misleading, for there may be, and usually are, many contributory circumstances, the removal of any one of which would mean that the accident would not have occurred. In nearly all accidents there is an error of judgment; but it is, of course, of little value to learn from accident reports that in, say, 90 per cent of cases an error of judgment was the primary cause. What is of value is to know the circumstances which can be changed so as to avoid the consequences of a human failing.

Economic Studies

Within recent years there has been a growing awareness of the need for detailed studies of the economic effect of changes in road conditions. We can calculate with some exactitude the cost of carrying out a projected new road or road improvement, but we are quite unable to bring equal precision to bear when evaluating the benefits that the scheme will confer in the form of traffic improvements. To assess the full economic value of a scheme will always be a matter of some uncertainty. A road improvement may attract industries to an area which would otherwise have been unsuitable. In relatively undeveloped countries agricultural areas have been brought by roads into contact with large cities—with economic benefit to both communities. In other places engineering industries have been reorganised as a result of quick road transport, the benefits being far in excess of the saving in transport costs. Other difficulties may arise from the fact that many different pockets provide the money or effect the savings.

Recently the Road Research Board has set up a Committee on Economics to study these matters, and a preliminary review has shown that considerable inquiry will be needed before it becomes possible to assign more than rough limits to monetary values for the various elements of road transport. It is clear, however, that the factors can be broken down into groups, namely, mechanical costs, time costs and accident costs.

The "mechanical" side of the problem will require answers to such questions as "What is the cost of stopping and starting a vehicle?" "How does the cost of running a vehicle depend upon the speed at which it is run, the load, the gradient of the road, the curvature, or the number of bends in the road, the road surface, and so on?" Although certain American estimates are available on some of these matters, wide gaps in knowledge of British conditions still remain. The Road Research Board, co-operating with the British Transport Commission and the Motor Industry Research Association, hopes to obtain many of the data—either by direct experiment or, wherever possible, by studies of figures supplied by transport operating concerns.

In considering the value of time we are in more troubled waters, for time is a commodity to which different values are attached by different persons and even by the same person on different occasions. It seems likely, however, that the problem can best be considered in two parts, the first dealing with "working" time and the second with "leisure" time. Of the two it is, of course, much easier to make a useful estimate of "working" time, but the question of the value of "leisure" time should not be dismissed as impossible to answer. Even if quite low values are given to the time element in traffic problems, it is found that a saving in time can often result in very considerable savings in terms of money. The problem is recognised as one of great importance.

I have already spoken about accident potentials. To turn these into costs, making due allowances for the severity of the accident, whether fatal or causing injury, serious or slight, does not present the same difficulty. Professor J. H. Jones estimated the pre-war cost of accidents to be £60,000,000 a year, and he also worked out costs for degrees of severity. These provide a starting point from which adjustment can be made to suit present costs and conditions. We should always bear in mind, however, that human distress such as is occasioned by road accidents can never be evaluated solely in economic terms.

Some General Considerations

My review this evening has been concerned for the most part with the technicalities of roads and road usage, and I have said little about the wider aspects of policy and planning which also lie within our ambit as engineers.

I fear that little will be done to put our roads in order until there is a complete change in the outlook towards roads and traffic in the country as a whole; a more general appreciation of the fact that things are by no means what they could and should be, and that safe and free road travel should be regarded as an essential ingredient of our civilisation. The Alness Committee were "amazed at the apathy" shown by the public: how to change this apathy into concern and action troubled them greatly. They were "satisfied that there is no panacea for the mischief." That remains true. There is no alternative but to tackle the problem by direct assault from all sides. But this will be possible only if someone can succeed, as Telford did, in obtaining acceptance of the fact that "by judicious expenditure of money in the cause of transportation they would indeed help forward the cause of civilisation."

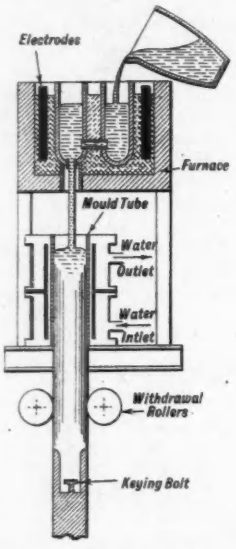
In bringing my Address to a close I should like to say that I did not set out to stress the need for better roads, but, as the subject developed, my thoughts have led me in that direction. My intention was to review the changes in our roads that have taken place since Sir Henry Maybury's day, and then to conclude my Address with a few more general remarks about the civil engineering profession. May I, however, permit myself one concluding thought? Civil engineers of character and ability are probably more numerous to-day than at any time in the history of the Institution. Against great odds they are achieving wonders. But we must do our utmost to ensure that the engineer is given every opportunity to give of his best, in whatever capacity and in whatever part of the world he may be working. At home, a watchful eye must be kept for those who would erect artificial boundaries of responsibility and, in doing so, would so circumscribe him that his advice is lightly treated. It is of the greatest importance that technical advice should be given greater weight in formulating policies at a high level—the responsible engineer should always be in a position to play his full and personal part in the reaching of decisions. His status should be such as to afford him a full opportunity of presenting the merits of his proposals—whether in private industry, in State industry, or in Government activities—to the body or person holding the ultimate responsibility. Any other course, in a world in which efficiency counts for so much, is the negation of common sense. It has been truly said that the condition of liberty is eternal vigilance, and the engineer must beware lest in accepting the position of the technical slave he thereby becomes the enemy of technical progress and thus the enemy of everything for which the Institution stands. Abroad, in a highly competitive world, the influence of the Institution should always be in the direction of ensuring fair play for our civil engineers and the right atmosphere for them to plan and build their share of the great works of construction that are so desperately needed.

In adopting this attitude, however, the engineer must make quite sure, doubly sure, that by keeping abreast of modern developments, by fanning the spark of adventure in his outlook and practice, by the breadth of his learning, by his understanding of his fellow men, and above all by the quality and sincerity of his service, he deserves, and by doing so, preserves, his rightful position in the community.

Wartime Packaging in Germany.—B.I.O.S. Survey No. 31, "Packaging in Germany During the Period 1939–1945," surveys those fields of German wartime packaging covered by B.I.O.S., &c., reports previously issued. In general there were no outstanding developments in Germany which are likely to be of value to British industry. There are, however, a number of points of interest which should repay investigation, e.g., references to vegetable parchment, transparent wrappings and food canning. There are notable gaps in the subjects included in the survey; for example, no useful information is given on any type of wooden container. The survey contains nine sections, covering paper, board, parchment, films and foils, metal containers, plastics, glass, textiles, adhesives and adhesive tapes, rot and fireproofing and corrosion prevention, food packaging and filling machinery, each of which has been prepared by an expert in the particular branch of the packaging industry. B.I.O.S. Survey No. 31, prepared by the Technical Information and Documents Unit of the Board of Trade, is available from H.M. Stationery Office, York House, Kingsway, London, W.C.2, and branches, price 2s.

B.I.S.R.A. Physics Laboratories

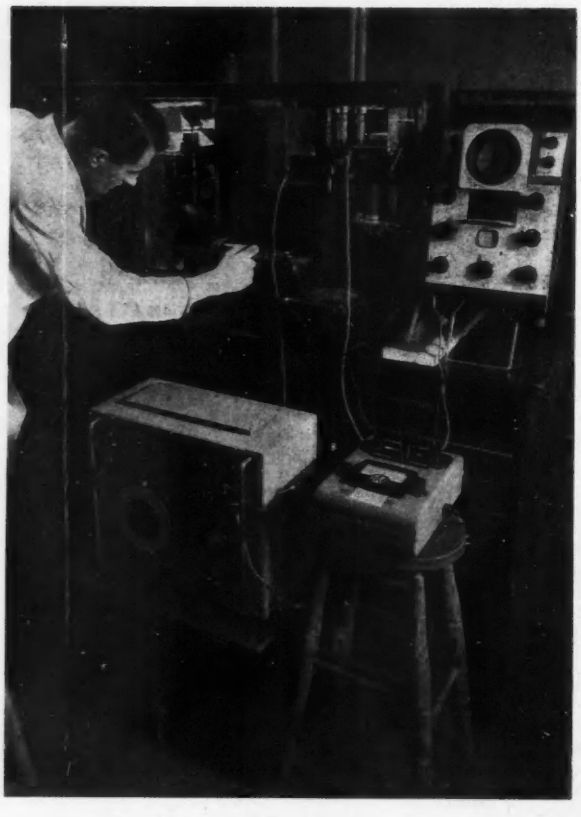
TO mark the third anniversary of the opening of its physics laboratories at Battersea, the British Iron and Steel Research Association held two "Open Days" last week, and visitors were given an opportunity to inspect much of the interesting and useful work now being done. The functions and some of the work being carried out in the physical laboratories were given in THE ENGINEER of October 31, 1947, at the time of the opening. Some of the present activities of the laboratory are described in a booklet "Physics and the Steel Industry," made available to the visitors on the open days.



APPARATUS FOR CONTINUOUSLY CASTING STEEL

During the past three years two groups of investigations with which the general physics section of the laboratory have been engaged concern the possibility of continuously casting steel, and the behaviour and properties of steel at temperatures right up to the melting point. It is obvious that considerable economies could be effected if a system could be developed of casting steel continuously through a mould that would produce solid bars direct. Work carried out on this subject has been directed towards finding out what were the physical processes underlying the major obstacles to the continuous casting of steel, to study these physical processes and make recommendations on the possible range of application in the steel industry. In this connection laboratory apparatus has been developed giving a throughput of the order of 1 ton per hour per mould, and it is stated that there is every reason to believe that this figure can be increased by a factor of ten.

A diagram we reproduce on this page shows the apparatus which has been built in the laboratory for experimental work in continuously casting steel. The experiments have been mainly on casting 2½in diameter bars with a mould length of 1in. To start the moulding operation a dummy bar is inserted into the mould and to prevent the splashing of liquid steel on the mould wall a hollow steel tube, which is a sliding fit in the mould, is screwed on to the bar. The liquid steel first entering the mould freezes and keys on to a bolt at the head of the dummy bar; withdrawal is effected by knurled rollers which grip the bar and later the cast ingot as it emerges from the mould. Although encouraging results have been obtained with this experimental continuous casting process some major problems remain to be solved before commercial application is likely to be seriously considered as economic.



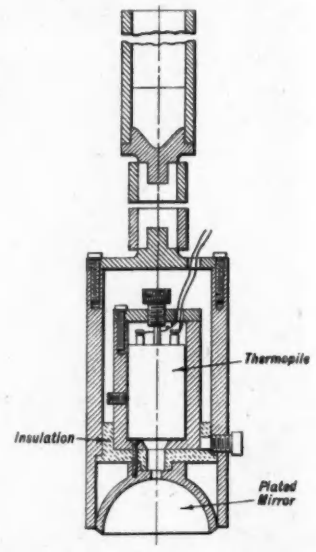
APPARATUS FOR MEASURING WIDTH OF CONTINUOUS STRIP

In studies of the high-temperature properties and behaviour of steel rheological, microscopic damping capacity and X-ray diffraction methods are being used, and in many cases new techniques have been developed. An interesting microscope has been developed for the observation of transformations and grain boundary movement of metal specimens while they are being heated in a small furnace. In this apparatus the microscope is arranged round a small furnace, and by using a system of mirrors the difficulty of bringing the objective near enough to the hot specimen without damage is overcome. The mirrors produce an image of the specimen and this image is examined with the microscope. The mirror system has been designed with a numerical aperture of 0·7 so that a microscope objective of the same aperture can be used without any loss of resolution.

A new X-ray method has been developed for examining phase transformations whilst they are occurring in steel specimens at high temperatures. The principle underlying this work is that crystals can reflect X-rays provided that the spacing of the layers of atoms in the crystal, the wavelength of the X-rays and the angle at which they meet the atomic layers bear a certain relationship with one another. Hence measurements of the reflection enable the layer spacing to be calculated.

An apparatus to measure the width of hot rolled strip continuously as it emerges from the rolls has been developed in the instrument section of the laboratory. With this instrument, which is illustrated on this page, actual contact with the moving strip is not required; it continuously monitors the width in spite of lateral or vertical movements of the material up to ¼in each way.

In this strip-measuring apparatus a parallel beam of light passes round the material in such a way that the edges of the strip intercept opposite sides of the light beam. The residual light flux in the beam is a measure of the strip width and independent of the position of the strip in the two beams. A photo-cell which is illuminated by the residual light also receives radiation from a comparison beam derived from the same source as the measuring beam. This photo-cell, via a suitable amplifier, generates a signal related to the unbalance between the two beams. The signal actuates a shutter in the comparison beam to maintain a balance position. The shutter position follows variations in the width of the strip and the instrument calibration is independent of changes in lamp brightness or gain of the amplifier or photo-cell systems. Modulation of the light beam at the source end ensures that radiation from the hot strip does not affect the reading.



HEMISPHERICAL MIRROR PYROMETER

The heat and thermodynamics section of the laboratory has been concentrating on two particular groups of problems. The first problem concerns temperature and radiation measurements of liquid steel, solid surfaces and flames; it includes the development of apparatus for carrying out sub-standard calibration in steelworks of the temperature and radiation measuring equipments which are becoming widely used. During the last year laboratory and large-scale experiments have been started with the object of enabling designers to predict the radiation from luminous flames.

In connection with surface temperature measurement a new method has been developed for successfully measuring the temperature of masses of steel undergoing annealing, ingot moulds, rolled sheet, &c. One of two prototype instruments is the hemispherical mirror pyrometer shown in the diagram reproduced above.

This pyrometer consists of a thermopile which receives radiation through a small hole at the top of a hollow steel hemisphere plated with platinum on the inside. To obtain the temperature of a surface the base of the hemisphere is placed on the surface; then, except

for radiation passing straight through the hole at the top, the radiation of all wavelengths will be reflected back from the platinum surface. Radiation closely approximating to the full radiation at the temperature of the surface will pass through the hole, and the effective emissivity of the surface as viewed by the thermopile is, therefore, almost unity. The instrument is independent of emissivity over a wide range. It has been calibrated on four different surfaces of emissivities ranging from 0·5 to 0·8 and the curves are stated to be virtually indistinguishable.

The aerodynamics section of the laboratory is engaged in investigating the fundamental characteristics of the flow of gases in furnace systems, and the flow of those liquids and granulated solids which are of importance in steel-making. Up till now rather more than half the effort of this department has been concerned with aerodynamic problems arising in open-hearth furnaces, and it is stated that this work is already beginning to bear fruit in industry.

In addition to the few examples of the laboratory's activities mentioned, the visitors during the open days were able to inspect and discuss with the staff very many other activities, developments and research work now in progress and projected.

Aluminium Strip Mill at Rogerstone

No. III—(*Continued from page 353, Oct. 6th.*)

Electrical Drives

IN the first and second parts of this article we gave a general description of the new rolling mill, but printing restrictions unfortunately prevented us from referring, in any detail, to the various electrical drives and control arrangements, some aspects of which are of special technical interest. The aim of this article is to fill some of the gaps, with particular reference to the hot rolling line and the run-out table, trimmer and coiler.

Hot Rolling Line

To recapitulate, briefly, the hot rolling line (page 321) consists of two independent reversing mills, followed by two mills working in tandem, together with the associated live roll conveyor tables. In this plant hot rolling is a continuous process during which the pre-heated slab is passed directly from one mill stand to the next and is coiled at the end of the line.

Breaking-Down Hot Mill (No. 1 Stand)

After leaving the pre-heating furnace the slab is conveyed by a feed table 108ft long to the breaking-down hot mill, which is directly driven by a 2000 h.p., 440V d.c. compensated shunt reversing motor having a maximum speed of 51 r.p.m. Power for this motor is obtained from a 2350kVA motor generator set comprising a 2420 h.p., 11kV synchronous motor, designed for operation at 0·8 p.f. leading, direct coupled to two 850kW generators. Ward-Leonard control is used for the main drive and for the live roll conveyor motors; the main exciter is driven by a 70 h.p. motor, the booster set controlling the last two entry

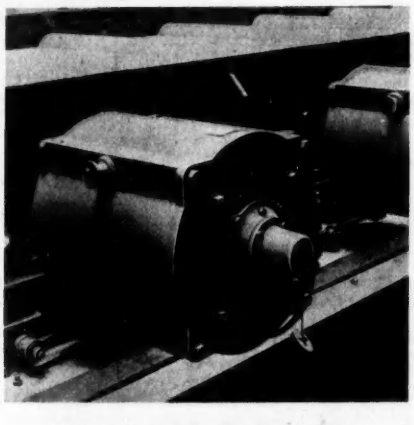


FIG. 1—RUN-OUT TABLE MOTORS

tables of the conveyor is driven by a 40 h.p. motor, and there is a 130 h.p. booster set for the remaining tables. The motors of all these sets are 400V machines.

The filter and the first and second live roll tables which receive the ingot after its withdrawal from the preheat furnace are driven by 460V d.c. motors connected (like the mill screw-down motors) to the constant-voltage shop supply. To allow for change in the speed of the slab as it passes through the mill the remaining six entry tables and the four delivery tables are fed from the generator busbars, through boosters.

The facilities for turning the ingot before it enters the mill are interesting. Two of the entry tables immediately preceding the mill are divided into two sets of rollers, disposed one on each side of the centre of the line of travel. By driving the rollers at different speeds or in opposite directions the ingot can be turned. For this purpose the two sides of the conveyor system are driven by independent motors connected across the busbars of the mill generators; each motor has a separate series booster, so that the ingot can be turned by driving the rollers in opposite directions when the other live roll tables are stationary, or at different speeds when they are running.

Two operators, working in the same cabin, are required for control of the breaking-down mill. One controls the ingot tilter and the entry tables, including the turning table. The other operator, however, is not only responsible for the mill, screw-down and delivery tables during rolling, but he exercises overriding control over the first four entry tables. The air-hydraulic pushers for centring the slab are actuated electrically from the control cabin. Lever controls are used for the direction and speed of the mills and live rolls, while a gate controller is used for the screw-downs.

After rolling in the breaking-down mill the slab is run out towards the intermediate hot mill, where the operator can assume control as the slab passes on to the last delivery table.

Intermediate Hot Mill (No. 2 Stand)

In its operation and control the intermediate hot mill is generally similar to the breaking-down mill. However, a different arrangement was adopted for the power supply, because the mill was not specially ordered for the duty in hand and use was made of available equipment. Accordingly, duplicate Ilgner sets working in parallel in one of the works substations supply the 1650 h.p. mill motor. Each set is driven by a 1000 h.p., 11kV induction motor, the two 1190kW generators being connected, through circuit breakers, to common busbars. Power supply for the live roll tables is derived from a 334kW motor generator set, with a 230 h.p. booster set for speed control. A 175 h.p. motor generator set serves the edge trimmer.

Unlike the breaking-down mill the intermediate mill is equipped not only with centring pushers, but with side guides which can be operated automatically so that the guides at the ingoing end are preset with the desired clearance while the guides on the outgoing side are left wide open, reversal of these settings taking place with reversal of the mill. The setting of the guides is electro-hydraulic, control being obtained by push-button-operated motors. A change-over switch on the control desk has "auto" and "hand" positions; on "hand" control the guides are adjusted individually by local push buttons.

Intermediate Shear and Trimmer

Between the intermediate hot mill and the two stand tandem hot finishing mills a shear and a trimmer are installed, together with the associated control desk. This desk can also take over control of the four delivery tables from the intermediate mill, the entry tables of the tandem mills, the side guides and the centring pusher. Embodied in this control system are Selsyn width indicators for the side guides and appropriate controls for the scrap cutter, conveyor and other auxiliaries.

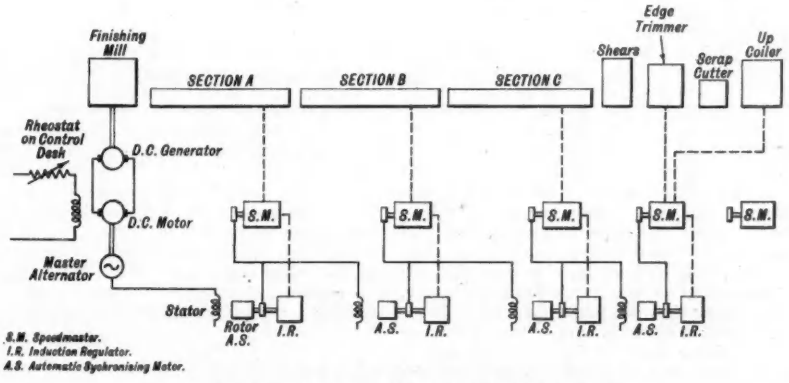


FIG. 2—PRINCIPLE OF SYNCHRONISING EQUIPMENT

Through a two-position switch on the desk the speed of the tables and trimmer can either be varied by a local control lever or be co-ordinated with the speed of the first finishing mill stand. Accordingly, as the strip leaves No. 2 stand (the intermediate mill) the procedure is to work on hand control up to the shear where the leading end is cut, through the trimmer and on to the first finishing stand, where the control is switched over to the "Mill" position, whereupon the operator of the finishing mill takes over.

Hot Finishing Mills

Initially the hot finishing mills comprise two stands (Nos. 4 and 5) working in tandem, but two more stands (Nos. 3 and 6) are envisaged and the electrical equipment for one of them is partly installed. Of the existing stands the first is direct driven by a 3000 h.p. motor running at speeds up to 96 r.p.m. while the second is driven, through a 1·57/1 gearbox, by a 2600 h.p. motor having a maximum speed of 400 r.p.m. A 440V supply for these two d.c. motors is taken from two similar motor generator sets driven by 11kV synchronous motors, each rated at 2870kVA and designed to operate at 1·0 p.f. at 3700 h.p. Automatic controls allow the sets to be operated either at constant power factor or at constant reactive kilovolt-amperes, irrespective of the shaft load. In the same substation as the motor generator sets are a main exciter set driven by a 110 h.p. motor, a looper set driven by a 23 h.p. motor,

and an amplidyne set driven by a 40 h.p. motor for each synchronous motor.

Ward-Leonard control is used for the mill motors, the speeds of the two stands being set in accordance with the reduction in strip thickness produced by the first stand, adjustment being made to maintain the desired tension between stands, making use of a looper roll motor driven by a high-torque motor.

For local use each stand has indicators, controls for screw-downs and side guides, and an emergency push button for applying dynamic braking to stop the mill quickly. However, the main control of the mill is exercised from a large cabin commanding a view of the bay, so that the operation of the whole hot line can be co-ordinated through an intercommunication system incorporating microphones and loudspeakers at each of the five operating positions.

A comprehensive system of indicators and controls is at the disposal of the finishing mills operator, who can "inch forward," "inch reverse," lower and raise generator volts, and "trip" and "reset" both stands together. Associated with each stand, individually, there are coarse and fine speed controls for the motor, an ammeter to show the motor load, screw-down controls and indicators, and a tachometer to show the linear speed of the work rolls with a calibrated rheostat to allow compensation for variations in work roll diameter. The same desk houses the controls and indicators for the mill run-out table. Normally, the table speeds are preset, but, by means of transfer switches, control of the tables can be delegated to the run-out table operator, and there is provision for full manual speed control. Finally, the main desk embodies controls for the water sprays, which cool the strip, before coiling, to the desired level as shown by temperature indicators.

All the main driving motors, motor generator sets, auxiliary machines and control gear on the hot rolling line were made and installed by the British Thomson-Houston Company, Ltd.

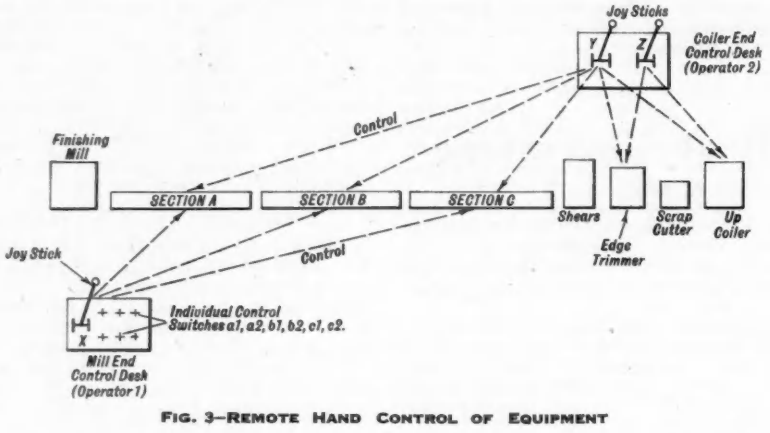


FIG. 3—REMOTE HAND CONTROL OF EQUIPMENT

RUN-OUT TABLE

A number of interesting innovations are embodied in the electrical drive of the run-out table (Fig. 1), which conveys the material from the finishing mill to the coiler. This table consists of 245 individually driven rollers (each 8ft long and 10in in diameter), equally spaced over a distance of about 735ft. As indicated in Fig. 2, the table is divided into three sections, with a separate "Speedmaster" frequency converter equipment to give a variable frequency supply to the roller motors in each section. Each "Speedmaster" set can be operated over a wide, smoothly variable frequency range to provide a corresponding speed variation on the roller table induction motors, the edge trimmer and the coiler motor; accordingly, the three sections of the table and the other components of the system can be run at different speeds to suit the particular operation required.

Additional flexibility of operation is attained by the provision of automatic speed-synchronising facilities between the finishing mill, the hot run-out table, the edge trimmer and the up-coiler. Finally, the system is characterised by the automatic transfer and discrimination of control which ensures that every part of the equipment is always under the control of the correct operator at the correct time in the duty cycle.

Each roller of the run-out table is driven by a totally enclosed, variable-speed induction motor nominally rated for 1·1/0·2 h.p. at 350/57 r.p.m. The motors (Fig. 1) are of "floating" construction, being specially designed to withstand the effects of vibration and shock associated with the operating conditions. To eliminate the flexible couplings and gearing normally associated with roller table drives, the motor has its rotor built on a sleeve which is mounted directly on an extension of the roller shaft.

The only connection between the stator and the framework of the table is through a ball-jointed tie-bar, which prevents rotation of the stator, but allows the motor to float freely on the rotor shaft extension. The motor can be removed simply by undoing a nut on the tie-bar and unscrewing the shaft screw which forces the motor off the roller shaft. A metal-clad plug and socket allows the electrical connection to any individual motor to be broken without interfering with the remaining motors.

Internal heating of the motor is kept to a minimum by the use of a variable-frequency supply. Starting and plugging are done at low frequency at which the kinetic energy of the rolls is low and the heat losses are correspondingly small.

The edge trimmer and up-coiler are both driven by totally enclosed "Emcol" variable-speed motors (type "NS"), which are supplied with a common variable frequency from a "Speedmaster" which is essentially a frequency converter that is capable of rapid and smooth adjustment of frequency over a wide operating range. The edge trimmer motor is rated at 131/18 h.p., 1240/170 r.p.m., 37/8 c/s, and the up-coiler motor is rated at 196/27 h.p. over the same speed and frequency range.

THE SYNCHRONISING EQUIPMENT

The scheme for synchronising the various sections of the equipment, as illustrated in Fig. 2, begins at the finishing mill to whose main motor is coupled a small d.c. generator. This machine supplies a variable voltage, proportional to the mill speed, to a d.c. motor driving a small alternator, thereby providing a variable frequency proportional to output strip speed of the finishing mill.

This frequency is fed to the stator of the synchronising motor on the "Speedmaster" set associated with table section *A*, while the rotor of the same synchronising motor is fed from the slip rings of this particular "Speedmaster" with frequency which is very closely allied to the linear strip speed on section *A*. If there is any difference between the stator and rotor frequencies on the synchronising motor, the latter rotates at a speed corresponding to the arithmetical difference in frequency, turning the induction regulator until the "Speedmaster" frequency is corrected exactly to the required value.

Due to the extremely small slip encountered in practice on the roller table motors, the linear strip speed on table section *A* can in this manner be synchronised with great accuracy to the output speed of the finishing mill. In order, however, to accommodate the normal requirement of running the table slightly faster than the mill, the master alternator frequency is increased slightly by means of shunt field adjustment on the d.c. motor driving the alternator, this relative speed difference being preset by means of a rheostat on the mill end control desk.

Table sections *B* and *C* are each synchronised to table section *A* in similar fashion, by comparing the output frequencies of the "Speedmasters" concerned and using any inequality in frequency automatically to rotate the synchronising motors until precise frequency synchronisation is obtained.

The same method is used for synchronising the edge trimmer and up-coiler with table section *C*, by comparison of the output frequencies of the respective "Speedmasters" but, in this case, a strict speed relationship is maintained, rather than an equality of speed, as on the three table sections.

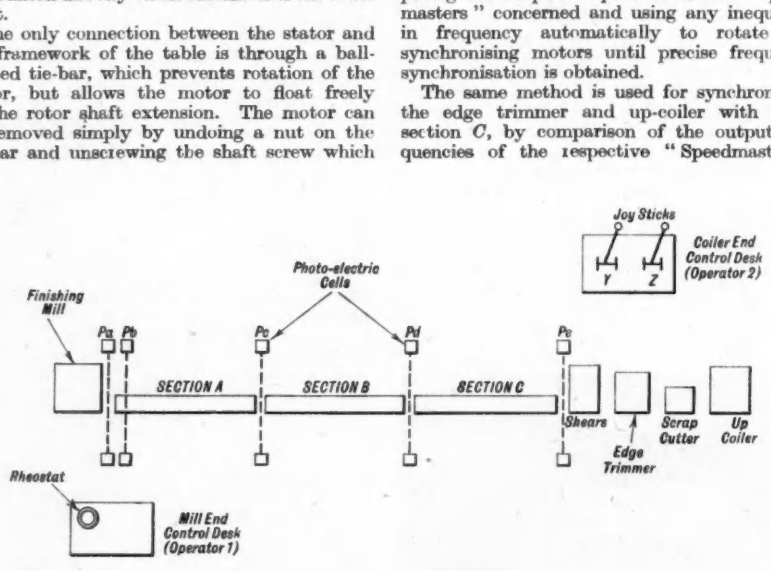


FIG. 4—AUTOMATIC CONTROL

In order to run the coiler at a proportionately higher speed than the edge trimmer and also to run the edge trimmer at a proportionately higher speed than the last table section *C*, the "NS." variable-speed a.c. motors are provided with small speed trimming induction regulators which permit the operator to preset this speed relationship by means of switches on his control desk. The use of variable frequency on these motors then ensures that this preset speed relationship is maintained over the complete speed range of the equipment without further adjustment.

CONTROL OF EQUIPMENT

Two main systems of control are employed on the equipment, remote hand control being

used for very short strips and automatic synchronising for longer strips.

Remote Hand Control (*Fig.* 3).—The coiler and edge trimmer are always controlled by operator 2, at the coiler end, but table control may be at either desk, depending on the particular operation required. The two operators can choose, in fact, which of the three table sections they wish to control from their respective desks, while interlocking prevents simultaneous control of any one table section by both operators. Transfer of control from one desk to the other is effected by means of change-over switches, while warning lamps and push buttons provide the operators with effective means of rapidly transmitting their requirements.

Operator 1 can control the three table sections individually by means of switches *a*1, *a*2, *b*1, *b*2, *c*1, *c*2, or, alternatively, can use joystick *X* for simultaneous control on all three sections during starting, stopping, plugging, reversing, accelerating or retarding.

At the coiler-end desk, all table sections, which have been transferred for control at that end, can be operated simultaneously in similar manner by joystick *Y*, while the same operations can be carried out on the trimmer and coiler independently of, or in conjunction with, the roller table on joysticks *Z* and *Y* respectively. The control of the coiler and trimmer is determined by a change-over switch on this desk, giving the above alternative control on the two joysticks.

The control transfer switches, already mentioned, enable operator 2 to release control of each table section in turn, in readiness for receiving the oncoming strip from the mill, while at the same time he is coiling the previous strip. Operator 2 also controls the shears, the coiler push-off and also the side guides associated with the shears, edge trimmer and up-coiler.

Automatic Operation (*Fig.* 4).—When automatic speed synchronising and automatic transfer of control are required, the table is first cleared of strip, after which control of all tables is transferred to the mill-end desk. Both operators then move their appropriate switches to "Automatic," thereby causing the table sections, the edge trimmer and the coiler to be synchronised in speed with the finishing mill.

Operator 1 adjusts the rheostat on his desk to give a synchronised table speed slightly higher than the output speed of the mill, in accordance with the specific requirements of the material being rolled. Meanwhile, operator 2 moves the trimmer and coiler control to joystick *Y* and adjusts the trimming induction regulators until the edge trimmer and coiler are running at their correct speeds relative to the table for optimum handling of the material concerned. Thereafter the automatic synchronising will maintain the correct speed relationships throughout the equipment and will cause the roller table, edge trimmer and coiler to follow precisely any changes in output speed of the finishing mill, the whole operation being accomplished without further adjustment from either operator.

It is therefore possible to continue sending strips from the finishing mill to the coiler without any control by either operator. In order, however, to permit operator 2 to retard or stop the strip on such occasions as shearing or measurements of temperature, width or gauge, a system of automatic control transfer has been interwoven with the automatic synchronising.

This system is operated by five photo-electric cells whose beams are interrupted by the strip on the tables. When the strip has left the mill and is resting completely on the table, its back end passes cells *Pa* and *Pb*, thereby restoring their beams; since the mill end operator will not require control of the tables until the next strip emerges from the mill automatic speed synchronising with the mill is temporarily broken and control of the complete table is immediately transferred automatically to operator 2 at the coiler end.

Then, irrespective of the mill speed this operator can accelerate the tables, edge trimmer and coiler to maximum speed by means of joystick *Y*, to deal with the strip as quickly as possible and to clear the table for the next strip. To ensure the same rates of acceleration or retardation on the table sections during such an operation, the pilot motors on the respective induction regulators are locked together during their rotation by an "electrical shaft," the synchronising motors being used in a dual role for this purpose.

After any such speed adjustment on joystick *Y*, the coiler and trimmer immediately return to automatic speed synchronising with table section *C*, unless at any time this synchronising is required to be broken by transferring to independent control on joystick *Z*.

While the strip is being controlled at the coiler-end desk, its back end is rapidly moving along the table until it clears section *A* and remakes the beam on photo-electric cell *Pc*. At this instant operator 2 has no further need of this table section, and therefore control of table section *A* is transferred automatically to the mill end where the section is at once automatically synchronised in speed with the mill in readiness for receiving the next strip.

As the strip continues on its journey along the run-out table, its back end passes the remaining two photo-electric cells, restoring their beams and immediately permitting the automatic synchronising to adjust the speed, first of section *B* and then of section *C*, to the correct value, as soon as the strip has cleared these respective sections.

This automatic transfer of control therefore breaks the synchronising immediately it is not required and restores the automatic synchronising to each table section immediately the latter is clear of strip.

There are two main advantages of this automatic synchronising.

First, it eliminates the majority of manual speed adjustments which the operators would otherwise be required to make. Since this synchronising gives very accurate speed control, the formation of loops, usually resulting from variations in the human element, is prevented.

Secondly, automatic table control transfer, by means of the photo-electric cells, ensures correctly timed operation throughout and relieves the operators of concern regarding conditions at the far end of the table, thereby permitting them to concentrate more on operating the other equipment under their control. Automatic transfer is a considerable asset in a plant of this size, since neither operator can appreciate conditions at the far end of the table and both must otherwise rely on messages or signals concerning such conditions at the other end.

The run-out table roller motors, "Speedmaster" sets, and edge trimmer and coiler motors were made by Laurence Scott and Electromotors, Ltd.

Temperature Indication

Radiation pyrometry is employed for indicating the temperature of the slab at various stages in the hot rolling process, where the use of contact pyrometers would have necessitated stopping the plant. A low-temperature radiation pyrometer which is very sensitive in the infra-red range was specially developed for the purpose. The system can give reliable temperature indications down to 150 deg. Cent, or, in certain conditions, down to 100 deg. Cent. It is believed to be the first industrial installation of its kind.

Temperature heads are sited as follows:—At the tilting table on which the ingot is placed after extraction from the pre-heat furnace; at the incoming side of the finishing mills, and after the water sprays on the run-out table. From these instruments temperature indications are transmitted to meters on the main control desks in each of the control cabins, the indications being repeated in the central control cabin for the whole hot line.

The radiation pyrometers were developed and made by British Electronic Products, Ltd.

(*To be continued*)

A Southern Region Colour-Light Signalling Scheme

MECHANICAL signalling combined with the Sykes lock and block has given good service for over forty years between Battersea Park and Coulsdon North, on the Victoria to London Bridge lines, and between Bricklayers' Arms Junction and Croydon on the London Bridge to Brighton lines. By the end of the war, however, when the signalling equipment was found to be in need of replacement, the increased train services postulated an increase in track capacity. Accordingly, in 1946, it was decided to replace the existing signalling system by colour-light signalling to link up with existing installations and provide continuous colour-light signalling from Victoria and London Bridge to Brighton.

The work, which is estimated to cost nearly £1,750,000, will include the provision of eleven new all-electric signalboxes, and is being spread over six years. The first of four stages, from Bricklayers' Arms Junction to Norwood Junction North, was brought into use on the night of October 7/8, 1950. Stage II, from Battersea Park to Selhurst, is planned to be brought into service in 1952; stage III, from Norwood Junction to Gloucester Road Junction, which will provide the link between stages I and II, in 1954, and stage IV, from East Croydon to Coulsdon North, in 1955. The whole area (shown in the map on the next page) covers 98 track miles of colour-light signalling with continuous track circuiting.

Stage I

On October 7th/8th eight signalboxes in the stage I area, representing 279 working levers, were abolished and replaced by three new all-electric signalboxes totalling 147 working levers, also thirty-eight automatic signals, the whole covering 7 route miles or 28 track miles.

The new signalboxes are at Bricklayers' Arms Junction (fifty-five levers), New Cross Gate, as illustrated (seventy-one levers), and Forest Hill (forty-seven levers). Included in the signalbox structures are maintenance staff accommodation, relay (apparatus) rooms, accumulator rooms, stores and working accommodation as required. Equipment associated with the main signalling supply system is also housed at the signalboxes.

At signalboxes the lever frames are miniature individual levers with all-electric interlocking, each lever being fitted with two lock magnets, one for interlocking and the other for track and indication locking. All signal levers are fitted with back or normal indication locks, but front or normal selection locks are not provided. Normal and reverse track locks are fitted to each point lever. Behind each signal lever is repeated in miniature lights all aspects of the signal it controls—that is, red, one or two yellows or green. Running and shunt signals also have an "F" light indication behind the lever which, when illuminated, tells the signalman that the signal can be cleared by reversing the lever. Behind each point lever is an illuminated "N" or "R," indicating the position of the points it controls. Behind the lever frame is a large illuminated diagram of the area controlled by the signalbox, showing all signals, points and track circuits together with their identification numbers and letters. When a train occupies any track circuit, its presence is indicated on the illuminated diagram, so that signalmen are continuously aware of the position and movement of every train.

Magazine train describers are provided between all signalboxes to enable signalmen, merely by pressing an appropriate button, to advise adjacent signalboxes of the next train, its class and destination, there being an instrument at the "receiving" signalbox with descriptions corresponding to those on the instrument at the "sending" signalbox. The receiving instrument indicates the first, second and third trains, the indication is automatically

CENTRAL SECTION COLOUR-LIGHT SIGNALLING SCHEME

stepped up one as each "first" train is cancelled on passing the signalbox. There are fifteen sending and fifteen receiving instruments, together with associated equipment. At each signalbox there is telephonic communication with signals, adjacent signalboxes and "traffic control," the telephone positions being duplicated as necessary so that the booking lad can also deal with calls.

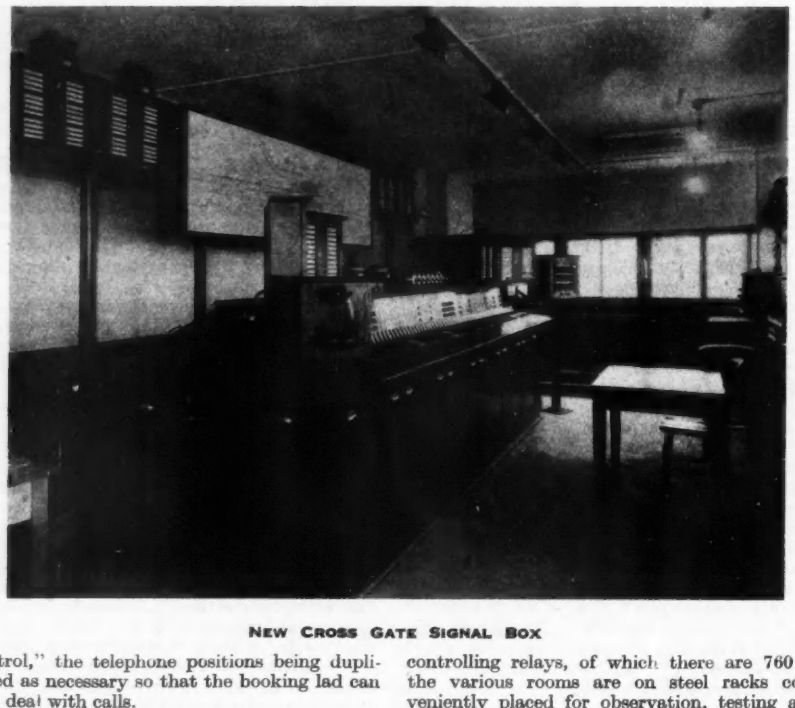
Our illustration of the New Cross Gate signalbox shows the signalman's telephone and train describer transmitter at each end of the frame, and the train describer receiver alongside the illuminated diagram behind the frame.

There are ninety-six four-, three-, two-, and single-aspect main and subsidiary colour-light signals of the long-range variety, the castings of which are in aluminium alloy. The signal lamps are 12V, 25W double-filament, separate transformers being housed in the signal casting to reduce the voltage, which for general distributive purposes is 110V. All colour-light signals are fitted with side lights. There are also seven multiple-lamp route indicators and thirteen junction indicators which are mounted on top of their respective signals instead of having additional supports. The signal spacing provides for 2½ minutes' headway, for following stopping trains. Shunting signals are solenoid-operated disc units and may be floodlit as necessary.

There are seventy-six electrical point machines, mainly operated from 120V accumulator batteries at the three new signalboxes, the batteries being float charged by rectifiers; there are also standby rectifiers at these boxes for direct-point operation if necessary. Points up to 500 yards from a signalbox are directly operated, but beyond that distance a contactor relay is employed, and supply to the machine is taken from a local rectifier. There are 140 condenser-fed a.c. track circuits, single and double rail, incorporating 150 impedance bonds. Wherever practicable, track relays are housed in the signalbox relay rooms, local controller rooms, or the apparatus cases of automatic signals.

The installation in general follows standard S.R. practice using lead-covered, multi-core cables—mostly 20 to 40 core—for signalling circuits and s.w. armoured lead-covered, paper-insulated cables for signalling power feeders. The cable route is, almost throughout, surface concrete troughing and the mechanical and electrical engineer's 3·3kV supply cable is carried in the same troughing—but in a separate sand-filled channel.

The relay room in each signalbox houses main transformers, fuses, rectifiers and all the control apparatus on which depends the safe operation of the system. The main signalling supply at each signalbox is 480V into the relay room from the mechanical and electrical engineer's portion of the signalbox; local distribution is at 110V, but all automatic signal and other major locations are fed at 480V. The

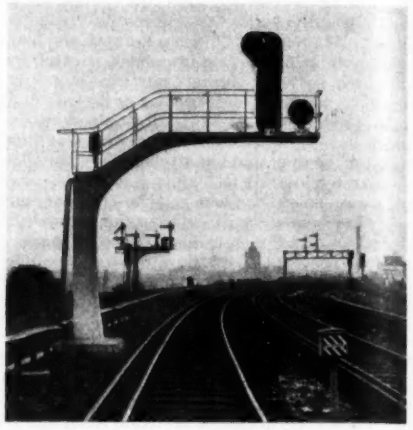


NEW CROSS GATE SIGNAL BOX

controlling relays, of which there are 760 in the various rooms are on steel racks conveniently placed for observation, testing and changing.

POWER SUPPLIES

To provide the power for the signalling scheme a 3·3kV, 50 c/s, three-phase distribution system is being installed. When this distribution system is completed it will form a ring main following the railway route between Waterloo and Croydon via Forest Hill and via Streatham. The first section—that between Waterloo and Croydon via Forest Hill—has been completed and brought into operation to supply the first stage of the signalling scheme. Whilst initially the distribution system has been provided to give signalling supplies, it is intended to develop it to distribute supplies for all railway ancillary services along its route. The whole of the power supply equipment comprising the 3·3kV distribution system is arranged for supervisory control from a central control room at Waterloo. Arrangements are provided



HOME SIGNAL NEAR BRICKLAYERS ARMS JUNCTION

to enable the equipment to be operated by remote or local control as required.

Power is taken at Waterloo from the London Electricity Board's 11kV, three-phase, 50 c/s system and transformed to 3·3kV for distribution to the signalboxes where single-phase supplies are taken at 480V/240V. The equipment at Waterloo comprises an 11kV switchboard, a 500kVA, 11/3·3kV, three-phase transformer, and 3·3kV switchboard. The 11kV switchboard consists of five metalclad, horizontal draw-out, oil circuit breakers and one metering panel. Two of these circuit breakers control two incoming feeders from the London Electricity Board; another circuit breaker controls the supply to the transformer, whilst the remaining two circuit breakers are for future extensions. The output from the transformer is taken to the 3·3kV switchboard, which is formed of three metalclad, truck-type, oil circuit breakers for controlling the supply to two outgoing feeders to the ring main. The rupturing capacity of each of the 11kV oil circuit breakers is 150MVA and that of the 3·3kV circuit breakers is 25MVA.

A 3·3kV, three-phase standby supply is available for feeding the distribution system in an emergency at the railway's traction substation at South Croydon. This supply is provided by means of a connection, controlled by an oil-minimum circuit breaker from the substation's 33kV busbars which are fed through the railway's 33kV network from the national grid. This 33kV supply is transformed to 3·3kV through a transformer of 500kVA capacity. A 3·3kV oil circuit breaker similar to the one at the Waterloo supply point, together with its auxiliary equipment, is mounted in a kiosk at the substation.

The ring main feeder consists of a three-core, 3·3kV, impregnated paper-insulated, lead-covered and armoured cable of 0·2 square inch cross-sectional area. With the power cable is laid a twelve-core, paper-insulated, lead-covered and armoured composite pilot cable. Four of the cores of the pilot cable are impregnated paper-insulated, laid up together, and screened to form the pilot wires used in connection with a "Translay" system of feeder protection. The remaining eight cores are dry-paper insulated, and are arranged in two

groups of four to form the pilot wires used with the supervisory control system.

In each of the new signalboxes where a 50 c/s, single-phase supply is taken, accommodation has been set aside to house the necessary switchgear and transformer equipment. The accommodation is subdivided into three sections, one for the switchgear and auxiliaries, and two for the duplicate transformers. The switchgear comprises a 3·3kV switchboard formed of units of truck-mounted, metalclad, oil circuit breakers, similar to those at the Waterloo supply point. One circuit breaker is provided to control the 3·3kV supply to each of the transformers, and one or more circuit breakers to control the sectioning of the 3·3kV system. Two standard sizes of transformers are used, 50kVA and 30kVA. The low-voltage connections from the two transformers at each of the distribution points are taken to change-over contactor equipment and so arranged that only one transformer is on load at any one time. In the event of the failure of the transformer on load the supply is automatically changed over to the second transformer.

Electrical supplies for the operation of the switchgear and of the supervisory remote control equipment are obtained from sixty and twenty-four secondary cell batteries respectively. At the Waterloo control room special batteries of 50Ah capacity are installed for this purpose, but in general d.c. supplies for operating the power supply equipment at the new signalboxes are obtained from batteries installed for operating the signalling equipment. The batteries are charged through metal rectifiers and are normally left on trickle charge.

In the construction of the signalboxes which were designed and built by the chief civil engineer, Southern Region, to the requirements of the signal and telecommunications department, various foundation problems were met with at each site. At New Cross Gate a reinforced concrete raft was used; at Bricklayers' Arms Junction, it was found necessary to put down in situ piles about 30ft long, whereas at Forest Hill mass concrete piers were built in pits carried down to a gravel stratum.

The signal supporting structures for stage I are all of cantilever construction, with a high standard of rigidity to give a steady colour-light beam. Most of these structures are of precast reinforced concrete (as illustrated), each comprising one large unit of about 4½ tons weight. They were made in Southern Region's concrete works at Exeter and transported to the site by rail and quickly erected by railroad crane on previously prepared bases of reinforced concrete.

The larger cantilevers, exceeding about 16ft and increasing up to 30ft, are of welded steelwork, metal-sprayed for long-term weather protection. These were supplied in two units each and were erected on previously prepared reinforced concrete bases incorporating heavy anchor bolts.

CONTRACTORS

The contractors for distribution system are as follows:—33kV switchgear and connections and supervisory control thereof, South Croydon substation and Three Bridges control room, Asea Electric, Ltd.; electricity meters, voltage and current instrument transformers, Chamberlain and Hookham, Ltd.; cable cleats, Waterloo supply point, Doulton and Co., Ltd.; 3·3kV and 480V switchgear at all supply and distribution points, supervisory control equipment, General Electric Company, Ltd.; 11kV switchgear and connections, "Translay" cable-protection equipment, Metropolitan-Vickers Electrical Company, Ltd.; 3·3kV cables, pilot cables, Pirelli-General Cable Works, Ltd.; batteries, Pritchett and Gold E.P.S. Company, Ltd.; battery-charging equipment, Standard Telephones and Cables, Ltd.; measuring instruments, Salford Electrical Instruments, Ltd.

The contractors for the signalling equipment are: bulk of signalling apparatus, Westinghouse Brake and Signal Company, Ltd.; remainder of signalling apparatus, Siemens and General Electric Railway Signal Company, Ltd.; telephone equipment, Siemens Brothers, Ltd.; signalling cables, British Insulated Callender's Cables, Ltd.; General Electric Company, Ltd., Glover and Co., W. T. Henley's Telegraph Works, Ltd.; Johnson and Phillips, Ltd.; Siemens Brothers, Ltd.; accumulators, Alton Battery Company, Ltd.

NATIONAL RADIO SHOW.—The Radio Industry Council announces that the eighteenth (British) National Radio Show is to be held at Earls Court, London, from August 28 to September 8, 1951, the first day being reserved for distinguished visitors, overseas buyers and the Press.

Marine Engines at The Motor Show

THE thirty-fifth International Motor Exhibition, which was held at Earls Court from October 18th to 28th, besides showing the new models of cars, caravans and accessories, included a motor-boat section, where various small craft and a number of low-power marine engines were on view. Most of the well-known manufacturers were represented and they displayed mainly ranges of well tried propulsion units, which did not embody any major changes in design, but incorporated improvements in detail.

There was a comprehensive range of engines on the stand of the Associated British Oil Engines (Marine), Ltd. The Petter A.V.2M, which is the marine version of the industrial

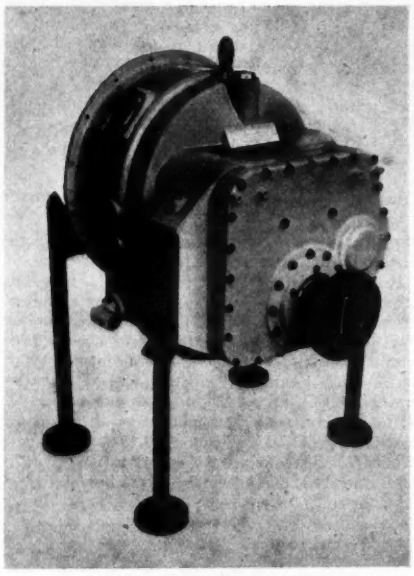


FIG. 1—MEADOWS-HOBBS GEARBOX

A.V.2, was shown; this vertical twin-cylinder, cold-starting, water-cooled, four-stroke compression ignition engine develops 10 b.h.p. at 1500 r.p.m. A Meadows reverse and 2 : 1 reduction gear is fitted and as an alternative the unit can be supplied with a sailing clutch. Standard stern gear is available, consisting of a manganese-bronze propeller, stern tube, tailshaft and the maximum angle for installation is 10 deg. There were the 12/28 h.p. "Kittiwake" and the 35 h.p. "Kingfisher" petrol engines, each of four-cylinder, four-stroke, overhead valve design, and in addition, the four-cylinder, 65 b.h.p. "Grenville" and the six-cylinder, 100 b.h.p. "Frobisher" four-stroke, direct injection compression ignition engines.

Another interesting exhibit, shown in Fig 1, was the new Meadows M.1000 RR oil-operated gearbox, built under the patents of Hobb's Transmissions, Ltd. It is operated by a small lever and transmits 320 b.h.p. at 2400 r.p.m. The gearbox casing is of cast iron and all the gears are nickel molybdenum steel, case-hardened and rated for 25,000 hours' minimum life at a maximum torque of 1000 lb feet. The case-hardened nickel chrome shafts run in heavy-duty ball and roller bearings. An oil-operated clutch transmits the power from the engine to the gearbox through a pressure plate moved into engagement with the clutch spinner by means of a synthetic rubber diaphragm actuated by oil pressure. The oil pressure is controlled by a floating valve in centrifugal balance with the column of oil leading to it. Upon the application of oil pressure the valve moves to the open position and oil enters the cavity behind the diaphragm to exert pressure upon it. Shutting off the oil pressure causes the valve to return and the oil exhausts centrifugally from the clutch through a port, while return springs disengage the clutch pressure plate.

Power is delivered to the shaft through either of two gear trains, one has two gears and the other three and if one is used for the ahead drive the other takes the astern drive and vice versa, the ratios available are 1 : 1, 2 : 1, and 3 : 1. The output shaft can be arranged co-axially with the crankshaft or offset 8·50in below it. In addition to the normal dipping, the gears are spray lubricated by means of the pump, which is fitted for the quick filling of the clutch, and a smaller pump maintains oil pressure after engagement of the clutch. The oil is passed through a cooler, which uses sea-water as a cooling medium, and is mounted in the sump of the clutch housing.

Another model of the gearbox, Mark M.450 RR, has been designed for use with the Meadows "Grenville" and "Frobisher" diesel engines. This has a maximum torque capacity of 450 lb feet, the gear ratios available are 1 : 1, 2 : 1 and 3·5 : 1, and the output shaft is offset immediately below the crankshaft centreline.

J. and H. McLaren, Ltd., exhibited its M4 and M5 four and five-cylinder units, having direct injection cylinder-heads in place of the former Ricardo Comet pattern, and developing 80 s.h.p. and 100 s.h.p., respectively, at a 1000 r.p.m. The small engine had a Meadows gearbox and the larger engine was fitted with a fluid-operated gearbox. A handed pair of six-cylinder indirect injection engines, developing 100 b.h.p. at 1500 r.p.m., having Ricardo Comet combustion chambers and built under the supervision of Lloyd's Register of Shipping, were shown by A.E.C., Ltd. The Austin Motor Company, Ltd., exhibited three "Skipper" high-speed petrol engines, developing 35, 60 and 100 b.h.p., respectively, and three "Chief" heavy-duty paraffin engines, embodying the Allday bi-fuel system, of 10 b.h.p., 25 b.h.p. and 40 b.h.p., and all using Parsons reverse gears. Besides exhibiting models of its well-known "Godiva" C.D.4 four-cylinder diesel engines of 30 b.h.p. at 2000 r.p.m., the Coventry Climax engines, Ltd., had on view a four-cylinder vertical two-stroke diesel engine, model KF., developing 50 b.h.p. at 2000 r.p.m. and employing a uniflow induction system. Another engine on the stand was

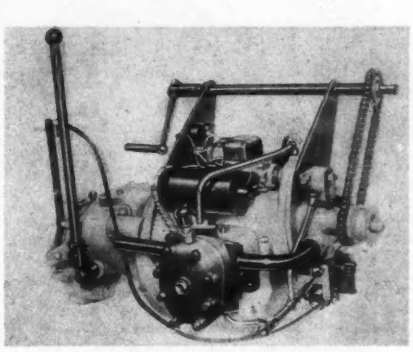


FIG 2—COVENTRY VICTOR TYPE "N" PETROL MARINE ENGINE

the new C.D.2; this is a balanced vertical twin-cylinder engine of 15 b.h.p., having evenly spaced firing impulses and balancing shafts, to give smooth running.

A full range of the products of the Coventry Victor Motor Company, Ltd., was on view, including single-cylinder, four-stroke, water-cooled diesel engines, of from 5 to 9 b.h.p.; the 3 to 5 b.h.p. "Zephyr" air-cooled diesel engine, and air and water-cooled versions of the horizontally opposed twin petrol engines of model N, (Fig 2) and midget designs. An item of interest seen on the stand was a self-streaming propeller, in which water pressure causes the blades to trail aft when the vessel is under sail. W. H. Dorman and Co., Ltd., included

three, four and six-cylinder versions of its D.L.M. model, having a maximum installation angle of 7 deg., a 4 D.S.M. four-cylinder engine developing 20 b.h.p. at 100 r.p.m., and an example of the 8 V.R.M., eight-cylinder vee engine, having a maximum installation angle of 9½ deg. It was noted that certain models were fitted with a reverse and reducing gear of British Twin-Disc manufacture. The principal exhibit of Gleniffer Engines, Ltd., was the D.H.6 six-cylinder diesel engine, developing 120 b.h.p. at 900 r.p.m., which is the D.C.6 completely redesigned, but retaining many well-tried features and including either electric or air-motor starting, the new air motors being of four-cylinder vee pattern, mounted in the flywheel casing. The second exhibit was the D.B.4 diesel engine, developing 48 b.h.p. at 1000 r.p.m.

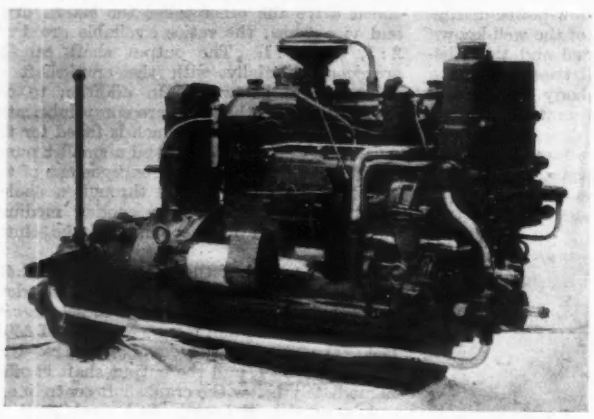


FIG. 3—MORRIS MARINE DIESEL ENGINE

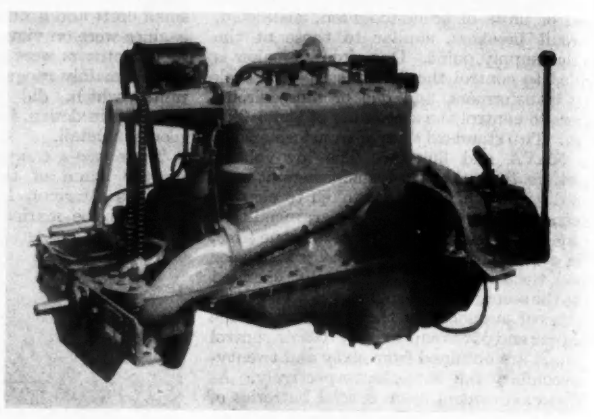


FIG. 4—PARSONS ENGINE TR4M

The engines shown by R. A. Lister (Marine Sales), Ltd., included three of the J.P.M. series, of two, three and four cylinders, developing at 1200 r.p.m., 21 b.h.p., 30 b.h.p. and 40 b.h.p., respectively, and a six-cylinder 616 M.G. diesel engine giving 62 b.h.p. at 1200 r.p.m. The company also had on view an example of its self aligning stern gear. Morris Motors, Ltd. (Marine Division), displayed a range of its well-known "Vedette," "Navigator" and "Commodore" petrol or paraffin engines and a six-cylinder 40/60 b.h.p. diesel model, which has been approved recently by the Ministry of Transport (Fig. 3). There was a new "Vedette" Mark IV, with an increased speed range and fitted for bi-fuel operation and a new "Navigator," Mark II, petrol or paraffin engine having a smaller capacity the bore and stroke being 73·5mm and 87mm, respectively. The marine conversions of Ford industrial units were the main exhibits of the Parsons Engineering Company, Ltd., including a C.4.M, a Ford 10 conversion; a V.8.M, which incorporates the Ford 30 h.p. V.8 engine and develops 70 h.p. at 3000 r.p.m., and a T.R.4M Fordson Major tractor unit (Fig. 4). The engines are fitted with Parsons reverse gears, which range from transmitting 7 h.p. to 100 h.p. at 1000 r.p.m.

Russell Newbery and Co., Ltd., has on exhibition two-cylinder and four-cylinder models of its D.M. series, developing 18 b.h.p. and 36 b.h.p. at 1000 r.p.m., and also a 120 b.h.p. six-cylinder diesel unit running at 1200 r.p.m. and having a power take-off at the flywheel end. In addition to showing models M.R.11 and M.R.10, which transmit a horsepower range of 25 to 65 and 60 to 120, respectively, the Self-Changing Gear Company, Ltd., exhibited its M.R.16, which covers horsepowers from 120 to 300, and has a power capacity of 3250 lb feet at 3000 r.p.m. ahead and 1000 lb feet at 1500 r.p.m. astern. This gearbox although designed for independent mounting, could be adapted for unit construction, and when required a helical spur reduction gear can be attached. Stuart Turner, Ltd., had on view a full range of its marine engines, lighting sets, pumps and stern gear and also showed a sectioned 8 h.p. engine, which is approved for Class "B" lifeboats.

The display of Thornycroft diesel marine engines consisted of several well-known units, covering the useful range of powers from 20 to 145 b.h.p., and several engines were arranged to demonstrate the operation of the oil-operated reverse gear with a single lever control at the helm. Another exhibit on the stand is the result of collaboration between John I. Thornycroft and Co. Ltd., the Rover Company, Ltd., and the Self-Changing Gear Company; this is the Thornycroft Rover "Meteorite" diesel (Fig. 5). The engine, which develops a maximum of 275 b.h.p. at 2300 r.p.m., has eight cylinders in two banks of 60 deg. vee formation and has been specially adapted for marine purposes. This "Meteorite" R.M.D., Mark 100, marine unit is very compact, has a high power/weight ratio and is intended particularly for fast craft. The Turner Manufacturing Company, Ltd., featured its 2.V.95 and 4.V.95, 68 deg. vee engines, the former developing 16 b.h.p. and the latter 33 b.h.p., at 1500 r.p.m. The four-cylinder engine embodied a Turner oil pressure-operated gearbox. A small fitting, which should give cleaner bilges, is an injector leak off, which is lead back from the injectors to outside of the filter and returned to circulation. University Marine, Ltd., besides showing a range of outboard motors exhibited a single-cylinder air-cooled 6¾ h.p. "Enfield" diesel engine and two examples of the twin-cylinder model, which develops 15 b.h.p. at 1800 r.p.m. and a maximum torque of 555 lb inch at 1150 r.p.m.

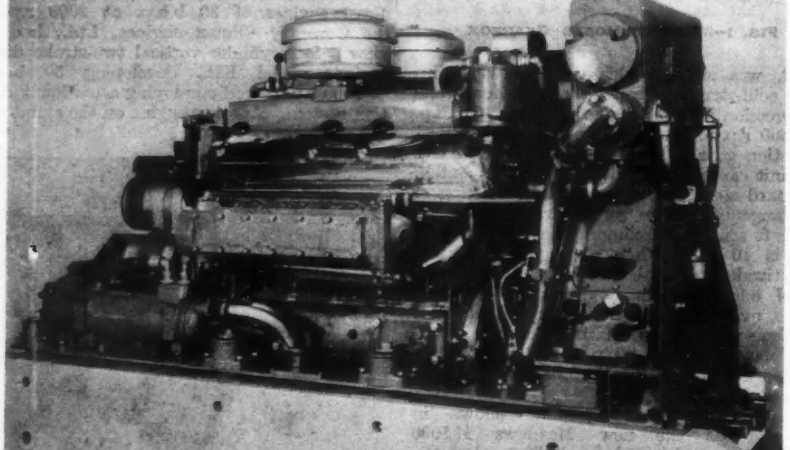


FIG. 5—THORNYCROFT-ROVER "METEORITE" ENGINE

The High-Speed Light-Weight Diesel Engine*

By Commander (E.) J. H. D. MIDDLETON, R.N. (Ret)

FOR twenty-five years the diesel engine designer has attempted to surplant the petrol aero-engine, offsetting the greater weight by reduction in fuel based upon horsepower hours and offering greater simplicity, reliability and safety. Regarding reliability the author mentioned that it is inversely proportional to the specific weight and mainly independent of the cycle used. Chorlton's Beardmore engine used for British airships and the Mercedes-Benz engine for Zeppelins were mentioned, and the author proceeded to discuss briefly various light weight engines.

The General Motors model "16—184A" ("Pancake") sixteen cylinder, two stroke, trunk-piston engine, developing 1200 b.h.p. at 1800 r.p.m. on a weight of 4·1 lb per horsepower, was illustrated by horizontal and vertical sections and detailed drawings. Despite adverse comments upon the design the engine gave good service and the complexity of the installation did not affect reliability, although the piston may have been the weak point. The adoption of the forged alloy steel head and steel skirt appeared sound, as did oil cooling and the creation of a heat barrier between crown and ring grooves by thin sections and a welded joint. The heat barrier was not effective and resulted in ring sticking. The author suggested the trial of an aluminium alloy piston and agreed that the tendency of the engine to smoke when

* Institute of Marine Engineers, October 16, 1950. Summary.

cold appeared to justify the severity of the scraping arrangements.

One of the first British attempts to produce a high-speed, light-weight diesel was the Paxman "Ex. 239 A" twelve-cylinder, 600-deg. vee, single-acting, four-stroke, trunk piston engine, with a maximum horsepower of 1000 at 1650 r.p.m. on 3·58 lb per horsepower and which was never put into production. Test engines revealed certain disadvantages which influenced the decision not to proceed and the author felt that this was to be regretted, because the cures for the major defects were fairly obvious.

Produced after a long period of strenuous development, the Junkers "Jumo 205 E," six cylinder, two-stroke, opposed-piston engine of 600 b.h.p. at 2200 r.p.m. had a light weight of 1·91 lb per horsepower and a low fuel consumption. Performance curves indicated that the engine was highly rated at 500 b.h.p. To obtain satisfactory combustion at the higher powers blower modifications were necessary and liner sections needed to be redesigned to avoid cracks developing at the higher b.m.e.p. The paper states that the thermal loading of the piston is higher than any other engine in serial production, and any increase in engine output would involve a problem of piston cooling.

Another British engine which did not reach the production stage was the Perkins "T 12," twelve-cylinder, 55-deg. vee, single-acting, four-stroke, trunk-piston engine of 1000 b.h.p. at 2300 r.p.m., and weighing 3·85 lb per horsepower. Taken over by the Admiralty for development, the engines were installed in a "B" class Fairmile boat without previous long endurance tests. After two years of teething troubles afloat further work was undertaken at the Admiralty Engineering Laboratory and finally the programme was abandoned. During this period the design had been modified considerably, crankshaft breakages remedied, better volumetric efficiency obtained, and only a further small amount of work would have produced a satisfactory prototype

Fitted in the "E" boats the Mercedes-Benz "MB 511" twenty-cylinder, 40-deg. vee, single-acting, four-stroke, trunk-piston, supercharged engine developed 2500 b.h.p. at 1650 r.p.m. on a specific weight of 4·2 lb per horsepower. In contrast with other engines it departed from the square concept and the weight of the resultant dimensionally large engine was only kept down by careful design and limiting thermal stresses to a minimum. Roller races gave high mechanical efficiency and individual oil pumps to each bearing reduced oil drag.

Lessons to be Learnt

From a study of the engines Commander Middleton thought it clear that the opposed-piston two-stroke had the lowest specific weight, the highest power loading on the piston and the most horsepower per litre capacity. Operational speeds which were noteworthy in the engines reviewed were a piston speed of 2750ft per minute (Mercedes Benz); exhaust valves operated 1800 times per minute (General Motors), and the injection and burning of fuel in 1/8800 of a minute (Junkers). The serial production of three foreign engines and the abandonment of the two British designs indicated that successful outline design was not enough, but detail refinement was required, and that final development must be carried out on the brake.

The author believed that there was a demand, particularly in the Navy, for an engine conforming to the following specification:—Weight, about 3·5 lb per horsepower; 2000 h.p., with 70 per cent continuous rating; 0·40 lb per brake horsepower per hour maximum fuel consumption; power range 10 to 100 per cent over a speed range of 30 to 100 per cent, and on a 60 per cent mean power factor the durability should be at least 500 hours and preferably 1000 hours before a 10 per cent drop in performance occured.

Design Considerations

Commander Middletor discussed certain design considerations to meet the specification. For several reasons he chose the two-stroke, setting the advantages of lower mechanical stresses, lighter structure, more even turning moment, simplified balance and torsional vibration problems, and smaller cylinder size against more difficult scavenging, higher thermal loading of the piston and high fuel consumption per unit of time. The small highly rated engine, he considered, should be lighter than the lower rated, and the reliability need not be decreased. A cylinder diameter of less than 7in was suggested by present industrial facilities. Other factors affecting the geometry of the engine were the need for short stiff crankshafts to simplify torsional problems, and to resist bending stresses; a short engine, which, due to beam strength considerations, allowed lighter framing; and a maximum block coefficient to secure economy of space suggested an H-type engine. The author stated that success or failure depends upon the mechanical details of construction and maintained that they should be left to the engine builder, but excluded the use of rare materials and insisted on simplicity.

In the final section of the paper a table gives the particulars of the engines discussed and includes an outline design designated "Project A." This is a two-stroke, single-acting, trunk-piston engine of H-form having twenty-eight cylinders and developing 3200 b.h.p. at 2400 r.p.m. on a specific weight of 3·0 lb per horsepower.

Finally the author commented upon the specification adopted, made comparisons with other engines, and gave reasons for the adoption of certain characteristics.

A National Plan for the Coal Industry

The National Coal Board has now produced its proposals for a national plan for Britain's coalmines and its report on the matter was put before the National Consultative Council of the Coal Industry on Tuesday last. Broadly, the plan proposes a balanced programme of capital development, designed to increase output, improve productivity and reduce costs, by employing men and money where they can produce the best results. In the next fifteen years the Board estimates that it will need to invest about £635,000,000. The execution of this plan, it is stated, will be in the hands of local managements. It is probable that over 250 of the 950 collieries now in production will be reconstructed and they will then yield nearly 70 per cent of all coal required,—estimated at 240,000,000 tons a year in the period from 1961 to 1965. Twenty new large collieries and about fifty new drift mines will probably account for another 10 per cent of the industry's total production, and it is thought that the remaining 20 per cent will come from some 250 collieries continuing in their present state without big technical reorganisation. This envisages, of course, that by 1961–65 more coal will be produced from fewer collieries. Between 350 and 400 pits, the plan says, will probably cease to have a separate existence, ninety of them being absorbed in other schemes.

It is calculated that, in ten or fifteen years from now, the reconstructed coal mining industry should need some 80,000 fewer mineworkers than are employed at present. The reduction will come about mainly because wastage over the years will exceed recruitment, but it is claimed that the plan will enable the reduced labour force to produce about 120 per cent of the present output of coal. With such an increase in productivity per man, the saving to the country is estimated—on mid-1949 prices—to be seven shillings a ton of coal. This, however, it should be noted, is a cautious estimate, made for investment purposes, and is based on conservative assumptions. But not all the saving will benefit coal consumers; the men employed in the industry will also share in it, since over the years their earnings are expected to increase with rising productivity. One chapter of the plan deals with the Coal Board's estimates of demand. It is explained that the Board must look ten to fifteen years ahead because of the time it takes to sink a new mine—or reconstruct an old one—and get it into full production. It is believed, however, that in the foreseeable future alternative sources of power are not likely to replace more than a modest fraction of the 500,000,000 tons of coal a year needed by Europe to-day. For the British coal industry in ten to fifteen years' time, inland requirements are placed at between 205,000,000 and 215,000,000 tons a year, and exports and bunkers at between 25,000,000 and 35,000,000 tons. The probable reserves of coal and the possibilities of mining them economically are also mentioned. The plan says that there is unlikely to be a shortage of coal in the ground, but most of the remaining reserves that can be mined economically are "general" coals and the special coals, like those ideally suited for coke-making, will grow scarcer.

In presenting this document the National Coal Board says that it is not a rigid plan and that "there are many uncertainties." There is nothing final about the period 1961–65, which has been chosen as the "base period," for this first national Plan for Coal. The plan is not static and from year to year it will be changed as new facts come to light about coal reserves, mining techniques, demand, manpower, transport and many other things. It is acknowledged that there will be plenty of scope for changes in the plan as the years go by. In particular, it is emphasised, no allowance has been made for the effects of new inventions and techniques, though, the Board says, "it would be surprising if fifteen years were to elapse without big advances of this kind." Revision of the plan will therefore be a continuous process, the objectives themselves being changed as more becomes known about production possibilities in the coalfields and about trends in demand. What the Coal Board has attempted to do is to map out the heavy tasks ahead, and it observes that how much the measures proposed will benefit the mining community and the nation greatly depends on the industry's endeavours over the years.

Technical Reports

Handbook of Chemical Methods for the Determination of Uranium in Minerals and Ores. H.M.S.O 1s. The value of mineral deposits containing uranium depends for final assessment on the results of chemical analysis. It is therefore essential that reliable chemical methods should be employed in this assay. This handbook describes procedures designed to deal with any type of ore containing from one-tenth per cent uranium oxide to high-grade pitchblende, which may contain 80 per cent uranium oxide. The recommended methods are based on the results of four years' experience at the Chemical Research Laboratory. They include new chromatographic techniques developed for the detection and determination of uranium and other metals. The first part of the handbook contains a concise description of the various methods. The second describes the working details which are recorded very fully for the benefit of chemists with little or no previous experience in this type of work. Analysts engaged in this field will have a selection of reliable methods to use, the choice depending on the nature of the material to be examined and laboratory facilities which are available. The handbook was prepared at the request of the Division of Atomic Energy, Ministry of Supply. The methods described are those which have been found most satisfactory in practice at the Chemical Research Laboratory.

Report on the Structural Use of Aluminium Alloys in Buildings. Institution of Structural Engineers, London, 11, Upper Belgrave Street, S.W.1. Price 3s. 6d. The design and fabrication of simple structural frames and members in a specific number of different alloys is dealt with in this report, which is intended to form a suitable basis for a contract specification. It is divided into five sections, the first of which is concerned with generalities and definitions, and a comparison of the properties of aluminium alloy and mild steel. Section two covers the specification of materials, and section three deals with the design of aluminium alloy structural members. Erection and fabrication processes are discussed in section four, and section five gives notes on fire and corrosion protection. A list is given of the appropriate British Standards which should be referred to in conjunction with the report.

THE ENGINEER

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NOTICE TO READERS

All letters intended for insertion in THE ENGINEER *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications.*

No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

For Subscription Rates, see page 2 of Advertisements.

HIGHWAY SAFETY

SINCE the war it has been very surprising to all concerned with the design of roads to find with what apparent equanimity the public has accepted the fact that, on average, more than a dozen people are killed every day in road accidents. It is true that something has now been done to break that equanimity. Recently, for instance, a running correspondence in *The Times* upon the subject has attracted much attention. But unfortunately many of the suggestions made in that correspondence for the reduction of the number of accidents on the roads are in fact quite irrelevant to the nature of the problem. The impression still obviously persists amongst several of our contemporary's correspondents that it is the wicked recklessness of the few that is the cause of road accidents and that therefore the imposition of more severe penalties on convicted offenders could greatly reduce accident rates. For our part we doubt it. Few such individuals exist as the "reckless motorist," the "careless pedestrian" and the "foolhardy cyclist." Users of the roads are normally careful and usually considerate. But all of them at some time—it is the consequence of their common variable human frailty—do reckless, careless and inconsiderate things. For the emotional state of the human mind varies from hour to hour and minute to minute. Nor can the inadequacy of many main roads in Britain to carry the amount of traffic that flows along them be held wholly unresponsible for the often aggravated state of mind of those who drive or walk or ride upon them!

The remedial measures needed to make our road system efficient, and by which accidents could undoubtedly be substantially reduced, are well known and have been known to engineers for years. They have little to do with the more rigorous application of the law. Those measures involve the construction of "motorways" and the improvement of existing highways through the segregation of fast and slow traffic, and the application, wherever possible, of safety measures analogous to those employed in railway working. There is abundant evidence to demonstrate the substantial reduction of accidents which can result even from merely minor improvements. Dr. Glanville, in the Presidential Address to the Institution of Civil Engineers, of which we publish some abstracts on page 455 of this issue, estimates that with vigorous action the accident rate could be cut by one-half in two years, or even possibly in one year. The well-known investigations carried out before the war by the Oxfordshire County Highways Committee showed that 59 per cent of accidents on the roads under its supervision could have been prevented by the removal of ordinary road defects, and 78 per cent by the realisation of an "ideal" scheme of modern lay-out. Accidents involving serious injury fell off by 76 per cent at the points improved in the rural sections of the five main roads of the county. Data from many other sources confirm the reliability of those results. The Ministry of Transport itself has been convinced and has laid down the standards to which a modern road system should conform in order to be as safe as engineers can make it, and the Government has itself recognised the need for comprehensive highway improvement by passing the "Special Roads Act of 1949," which authorises the construction of special "motorways." According to the calculations of the British Road Federation, the provision of a comprehensive system of modern motorways, together with corresponding improvements to highway facilities, would cost about £600 million. It estimates that the corresponding saving in maintenance and wear and tear of vehicles, and that due to a reduction in transit time, and the reduced cost to the community of accidents, would save about £60 million each year. Lest it be suspected that a body of the character of the Federation may show bias, it should be noted that Dr. Glanville gives a figure of £50 million per year as the saving if 50 per cent of road accidents were averted. Moreover, it is to be noted that even if the Federation's figures were substantially less favourable, a good case for immediate road expenditure would still have been made out. For it is surely worth some expenditure to reduce the toll of human suffering!

The reason why little is being done to improve the roads to-day—and the reason therefore why road casualties will, quite inevitably, increase as more traffic uses existing roads—is that, in its wisdom or its folly, the Government believes that the nation cannot afford the necessary expenditure under present economic circumstances. Here we enter upon grounds for argument that have little to do with engineering. But fortunately we can quote from Dr. Glanville's address to illustrate the very point we wish to make: "I will not digress," he said, "into an argument as to whether or not good roads can be afforded, for what can be afforded is a matter of outlook and habit. We have all known men with incomes of thousands a year who seriously say they cannot afford a packet of cigarettes, and we have known other men who earn £5 a week who smoke their daily twenty. It is solely a question of decision as to how income is spent." Dr. Glanville went on to remark, "the nation can have good roads if its desire to have them is strong enough." Is its desire strong enough? Certainly the increasing rate of accidents upon the roads is beginning to attract attention as the recent correspondence in *The Times* proves. But unfortunately that correspondence also revealed that many men in responsible positions are not aware, or refuse to believe, that engineers, given a freer rein to improve the roads, could, by such improvement, very substantially reduce the rate of accidents. Nor, we think, is it at all widely realised that expenditure upon road improvement could be economically as well justified in present national circumstances as expenditure upon much else which is accepted with little or no argument. We hope that Dr. Glanville's address will find an audience outside the engineering profession to which it was addressed. For, though engineers know that they can make the roads of this country better and very much safer, it is with laymen that the decision lies as to when the work shall be begun.

POWER ON THE LAND

THE rate at which the mechanisation of agriculture in this country has progressed in the last decade has surprised even its own ardent advocates. That pace was, of course, considerably raised during the war years by the over-riding necessity for this country to produce as much of its own food as possible. But in the years which have followed the war, dollar difficulties and a world scarcity of many commodities have continued to emphasise that the need for a large proportion of home-grown food has in no way abated. That, possibly, is the principal reason why, since 1945, the pace of farm mechanisation has not slackened. But, as engineers know well, there are occasions when tasks have to be performed hurriedly in order to meet the pressing need of the moment. There is then little opportunity to consider the long-term effect of those tasks, and when, subsequently, such an opportunity occurs, there may well be "second thoughts" as to whether what has been done has been done to the best advantage!

Those reflections have been stimulated by the interesting paper entitled "A Survey of Power on the Land," which was presented last week to a meeting of the Farmers'

Club, in London, by Mr. W. H. Cashmore, Director of the National Institute of Agricultural Engineering. In that paper, Mr. Cashmore pointed out that, since 1939, this country's arable acreage had increased from 11,870,000 to 17,400,000, that the horse population had declined by over 200,000, but that the tractor population had risen from about 55,000 to over 300,000. Even assuming a tractor to be equivalent to no more than four horses, he suggested that the available power per acre was now double that of pre-war. Thence, Mr. Cashmore advanced to the idea that agricultural mechanisation during the war years had been too rapid to allow careful planning, either by the farmer or the implement manufacturer. He agreed that there was no lack of ingenuity in the design of farm machinery to-day, but, he said, "some effort seems to be going into the production of machines and implements which can offer but small advantage to most farmers and there is real concern over the rising level of capital outlay on machinery." Agricultural engineers, we feel sure, will take careful note of Mr. Cashmore's views. It is true that, having become much more enthusiastic about mechanisation than they were in pre-war days, farmers have considerably increased the demand for new machines and implements, but they still rely upon engineers to provide equipment that will fulfil the claims made for it. Upon engineers, therefore, there rests the responsibility to produce machines which are not merely ingenious but which are fundamentally sound both in design and in purpose. Nor does mechanised agriculture end with the purchase and use by farmers of the range of implements that is now available for almost every job that can be mentioned. Mr. Cashmore said that capitalisation of £15 or more an acre on machinery was becoming fairly common. He added, significantly, that the maintenance charge on that machinery was sometimes as high as 15 per cent per annum of the initial price.

High maintenance costs tend to support the contention sometimes advanced, that farmers would find it a better proposition economically to have implements of a rather more primitive design but of greater reliability. But, for our part, we think that the problems which mechanisation has created, could never be solved satisfactorily by retrogressive design. There are preferable solutions to the problem. For instance, there are now some indications, as Mr. Cashmore hinted in his paper, that stability in the design of agricultural machinery is being reached. That being so, it would seem that the next tasks to which agricultural engineers can profitably turn their attention include some simplification of—and, we suggest, further standardisation amongst—existing designs. More attention might, too, be given to details of design so as to make for greater ease in maintenance. Furthermore, simplification might conceivably be carried far enough to permit machines to perform more than one operation on more than one crop. Up till now those who are farming on a big scale have benefited more than others from the progress of mechanisation. The aggregate effort of the smaller farms, however, represents no mean proportion of the nation's agricultural output, and the mechanical requirements of the small farmer cannot be met without the agricultural engineer's careful attention. That, Mr. Cashmore contended, is "still one of the major difficulties facing further mechanisation." In the last ten years or so agricultural engineers have proved themselves capable, by their ingenuity, not only of meeting a pressing need of the time, but also of showing that their industry is one of the foremost branches of mechanical engineering. Their prestige will be further enhanced and their usefulness increased if they now reveal that they are able to produce machinery which will be just as good an economic proposition to the small farmer as it is to the large.

Obituary

SIR GEORGE ERNEST CLARK, BART.

SHIPBUILDERS will regret to learn of the death of Sir George Ernest Clark, which occurred on November 10th at his home in County Antrim, at the age of sixty-eight. Born in 1882, he was the elder son of the first baronet, whom he succeeded in 1935 and who was one of the founders of the well-known shipbuilding firm of Workman Clark and Co., of Belfast. He was educated at Rugby and then spent some years in the engine works before proceeding to Trinity College, Cambridge, where he took his M.A. degree in mechanical science. In the following years Clark was assistant manager of Workman Clark and Co., and in 1917 became a director of his father's business, which was eventually taken over by Workman Clark (1928), Ltd. Throughout his life Sir George remained keenly interested in shipbuilding and, as a member of the Belfast Harbour Board, in the development of the Port of Belfast. He was a member of the Irish Lights Commission from 1939, deputy chairman of the Great Northern Railway Company of Ireland, and was elected a member of the Institution of Naval Architects in 1914. As a philanthropist he was well-known in Northern Ireland and in 1937 in association with his brother, made a magnificent gift of £100,000 to the hospitals and other institutions in memory of his parents. Among the many public offices which Sir George filled was that of the High Sheriff of County Antrim in 1940 and of County Down in 1941. At the time of his death he was deputy lieutenant of Belfast.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

SOME AMERICAN LOCOMOTIVES AND THEIR RUNNING

SIR,—I have been following Mr. Tuplin's narrative of his experiences on "Some American Locomotives and Their Running." In the September 1st issue, page 224, at the bottom of column 3, he makes particular reference to the inadequacy of the beam of light afforded by the electric headlight, i.e., only on "perhaps 300 yards." It must have been a very poor type of headlight, probably the bowl-shaped intended for floodlighting and switchers. I have had several years of experience on the footplate with electric headlights of the cylindrical pattern with cone-shaped solid glass reflectors, and with these lights, if they are kept in clean condition, the bulbs properly focused and the commutator and brushes of the turbo-generator kept in good order, the beam of light should extend for a considerable distance. Nor did I find it necessary to "switch off" or "dim off" to see signal lamps which are quite visible in the glare of the beam. On sections I have worked (seventeen telegraph posts to the mile) the eighth post has always been clearly visible, i.e., over 820 yards or 2460ft. So I should say, not "happily not a necessity on British railways," but very unhappily a very great necessity on our railways that has been long overdue, the delay of which is deplorable. Any engineman who has handled the proper type of headlight can tell you the tremendous advantage over running helter skelter in the dark. Many a major accident in this country would have been entirely avoided, as the light can be seen for miles away, an indication to signalman of an approaching train allowing them ample time for a change-over in case of a mistake having been made. Eight hundred yards is ample for an emergency stop for any fast train and leaves a fairly wide margin to spare. If there has been any misrepresentation by Mr. Tuplin's remarks, I hope these lines on the subject will put things in proper perspective.

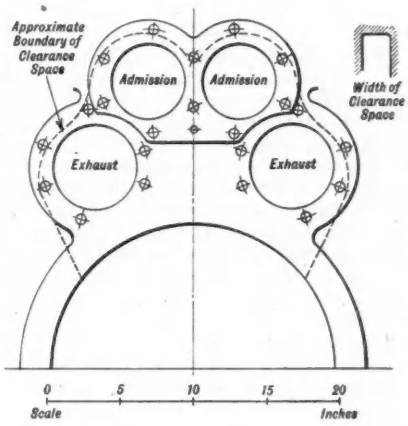
ONE WHO KNOWS

London, October 28th.

SIR,—The questions asked by Mr. Parker are pertinent and I wish I had precise answers to all of them. The greater liability of roller-bearing engines to slip is, I believe, the result of lower running resistance at low speeds than that of similar engines with plain bearings and probably disappears as drivers become accustomed to the need for a smaller throttle opening when starting. Incidentally, referring to Table VI, page 227, the weight of the engine in column 5, headed "Pennsylvania Q2, 4–4–6–4," should be 276 tons instead of 308 tons.

Mr. Parker's suggestion for a physical safeguard against running engines into turntable pits seems valuable, but perhaps mishaps have not been sufficiently numerous to inspire active adoption of it.

Mechanical stokers certainly are remarkable.



That a stoker-fed fire recovers from nine-tenths dead to fully alive in a matter of a minute or so seems to me to be proved by my observations on the N.Y.C. 4–8–4. The cinders were black (or grey) over most of the grate when the engine stopped at a station, the stoker was not set to work until just before the restart was anticipated, the engine was worked hard for at least a mile after each start and yet there was no appreciable drop in boiler pressure. This is perhaps difficult to understand, and it is difficult to believe even when seen, but it happened time after time.

The small coal and fine coal aimed at the front of the grate are ignited by flame from the fire bed at the back of the grate, the fine coal is lifted by the draught, and so the firebox contains flame from the jets before a bed of green coal has been laid on the old cinders. Fig. 1

(page 144, August 11th) suggests a flame originating from the jet rather than from the fire bed, and this is the probable explanation of the almost immediate recovery of the stoker-fed fire.

I confess that it did not occur to me to ask why hand brakes are not normally fitted to American steam locomotives even when I saw a 2in wooden plank placed under the wheel of a roller-bearing 4–8–4 to hold her on a slight gradient outside a roundhouse while her air brake was out of action during some adjustment of the compressor! Certainly the diesel locomotive hand brake is regarded in America as a notably up-to-date feature.

The accompanying diagram (p467) shows the approximate proportions of double-beat admission and exhaust valves as used on the Franklin system. The clearance volume is less than would be required if the same effective peripheral length of valve were to be obtained either in one double-beat valve for admission and one for exhaust, or in a conventional piston valve.

Walschaerts gear is used to oscillate the valve cams because it is a convenient means of varying the amplitude and phase of the cam motion. The alternatives are to use expanding cams or different cams for different cut-offs. For each cylinder the Franklin system provides one set of Walschaerts valve gear for the admission valves and a similar set for the exhaust valves. The positions of the die blocks in the links are not, in general, the same for admission and exhaust, and this independence (in the design stage) of timing of admission and exhaust valves is, of course one of the advantages of poppet valve systems.

I was, indeed, fortunate to be able to view American locomotive practice at close quarters but my attempt to describe some of its interesting features to readers of THE ENGINEER has shown me that there are a great many additional questions that I might have asked had I thought of them in time.

W. A. TUPLIN

Huddersfield, October 2nd.

THE SCIENTIST AND THE ENGINEER

SIR,—Your correspondent, Mr. Cowley, in his letter which appeared in your issue of September 22nd, seems to be confusing the scientist with the engineer. The two are not the same, nor are they on the same level, and it may help matters to consider their respective positions. Unfortunately, most engineers are hard-headed but surely the object of every scientist is to penetrate the fundamentals of Nature and the engineer is only concerned with these fundamentals after they have been uncovered by the scientist.

The scientist is an investigator of Nature and therefore I agree that his arguments border upon religion, but certainly not astrology. The final and unconditional guide is truth and agreement with reality. The whole universe is a great system of justice and eternal truth, and the true investigator applies all his effort, thought and reason to unveiling these truths and the laws of Nature connecting them. It is not to be wondered, therefore, that by comparison the efforts of the engineer do seem empirical and straight-jacketed.

I also agree that the time has come for the pendulum to swing back; back to true thought, not necessarily less spectacular logic. Mr. Cowley speaks of being mathematically equipped to follow the voluminous writings of modern science, but is this true science? The great scientists of the past regarded mathematics only as a means to an end, i.e., a means for carrying out without errors work previously done by pure thought in the simplest manner. What is now taught in educational institutions under the name of science can only be regarded as mathematical technique, and science taught in this way does not lead to the practice of simple and straightforward thinking in direct contact with Nature, whereby it could be of greater value to humanity, but is only a field for the practice of methods of calculation, a pleasure for small minds. In order that there may nevertheless be an appearance of actual science, experimenting in schools is carried out on an ever-increasing scale, technical achievements are examined and exhibited, usually of a complicated nature, again giving an opportunity for more calculation, while the simple ideas which have formed the basis of every scientific success in the past, and which are also of most educational value, are forgotten. Training at present-day universities is too often concerned with unnecessary matters merely for the purpose of examination and many of the students of these universities, as future teachers at schools, pass on to the next generation the same endless and useless information instead of imparting modest but accurate fundamental knowledge and encouraging the gift of correctly deducing unknown phenomena from known.

To me, the scientist is one who has brought forward something entirely new, having an essential bearing on our knowledge of Nature. This calls for an attitude of mind capable of clear, natural and devoted thinking and one deserving of the respect and reverence of all and in particular the engineer, for without the scientist the engineer would not progress very far along the road to civilisation.

F. R. WILSON

South Shields, October 3rd.

ENGINEERS AND EDUCATION

SIR,—It is well known that efforts have been made from time to time to federate the ever-increasing number of engineering bodies, due to the ever-increasing number of specialisations. Whilst there have been various registrations and amalgamations, the inevitable federation has not yet been accomplished. I have pointed out in the past that Italy found that her professional bodies were at a disadvantage compared with the trades unions in the matter of fees for work done, and formed a protective professional federation.

I think that such a federal body would be the proper authority to decide such a question as the desirability of candidates for engineering continuing to train at universities or withdrawing to engineering institutes for educational training. Professor Cook, who referred to this matter in a recent address to the Institution of Engineers and Shipbuilders in Scotland, thought such withdrawal would be a disastrous loss of culture to engineering professions.

To solve the problem we must look at the matter from several points of view. I believe the universities are already overcrowded, and it would be a relief to them if some classes of pupils were trained elsewhere. We must remember that the universities were founded for almost purely academic pupils, whilst the growth of population and the development of science naturally raises the question of the separation of constituent bodies. A university can be overloaded with curricula as well as with numbers of students. I think it possible to exaggerate the loss of culture. Very much depends upon the status of professors and the dignity of buildings.

There is also the question of the locality of buildings to consider. A great error has been committed in establishing so many professional institutions in London. If the Metropolis is to have a happier future than its present congestion allows, future institutions must be founded in other less congested centres.

It must also be remembered that capital is being distributed in far more hands. The heavy taxation of the present will operate to prevent those ancient endowments which laid the foundations of so many excellent schools and universities. The cost of erection of new universities will have to be derived from heavier fees and State endowments, and the federation of engineering bodies would promote this, on account of the number of candidates. Not only would technical universities absorb engineering students, but also candidates for such allied professions as surveyors and architects.

The Institute of Management created a few years ago was assisted in its formation with a State grant of £150,000 spread over five years.

A. W. CRAMPTON, F.R.I.C.S.

Hampstead, October 12th.

SCAVENGING OF TWO-STROKE DIESEL ENGINES

SIR,—Though I am not now connected with the oil engine industry, I must confess to an academic interest in its technical progress. I cannot therefore pass your review of Professor Schweitzer's book in your current issue, in which you make kindly reference to fifteen years of my own work in this direction, in column 3 on page 381, without the remark: "You're telling me"! It is unfortunately not generally realised in this country, as it is in Professor Schweitzer's country, how painstaking and long these developments must be.

CHARLES DALE, M.I.Mech.E.

Upminster, October 20th.

Literature

SHORT NOTICES

Machine Tools for Engineers. By Charles R. Hine. London: McGraw-Hill Book Company, Ltd., Aldwych House, W.C.2. Price 30s.—The author of this work is Assistant Professor of Manufacturing Processes at Rensselaer Polytechnic Institute, and the volume is the first evolved from courses held at that Institute, which endeavour to introduce engineering students to the fundamentals of machine tools and production processes. There is an initial review of modern cutting tool materials, shapes and motions, followed by a chapter on limits and fits and the measuring instruments employed in manufacturing shops. The main part of the book deals with machines, tools and methods involved in turning, threading, drilling, shaping and slotting, planing, milling, broaching, grinding, boring, gear-cutting and jig boring. A detailed account of lapping, honing and super-finishing operations is contained in a chapter on micro-finishes. Both a descriptive and an analytical treatment is given of all the more important machine tools and there is discussion of the ways in which machine tools affect the design of engineering products. A second, similar volume, on casting and forming, is in preparation.

BOOKS RECEIVED

Cellulose Acetate Plastics. By Vivian Stannett. London: Temple Press, Ltd., Bowling Green Lane, E.C. 1. Price 30s.

The Live Steam Book. By "L.B.S.C." London: Percival Marshall and Co., Ltd., 23, Great Queen Street, W.C.2. Price 12s. 6d.

Quality Control and Statistical Methods. By Edward M. Schrock. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 40s.

Estimating and Planning for Engineering Production. By P. S. Houghton. London: Blackie and Son, Ltd., 66, Chandos Place, W.C.2. Price 25s.

Technology for Sugar Refinery Workers. By Oliver Lyle. Second edition. London: Chapman and Hall, Ltd., 37, Essex Street, W.C.2. Price 32s.

Friction and Lubrication of Solids. By F. P. Bowden and D. Tabor. London: Oxford University Press, Amen House, Warwick Square, E.C.4. Price 35s.

An Introduction to Aeronautical Engineering. Vol. I, Mechanics of Flight. Sixth edition. By A. C. Kermode. London: Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, W.C.2. Price 18s.

The International Motor Exhibition

No. I

THE thirty-fifth Motor Exhibition, which ended on October 28th, attracted 475,000 people, 120,000 more than last year. Britain to-day is the world's biggest exporter of cars, yet nowhere in the world do so many people have to queue so long to obtain them. In France, Italy and Germany one can purchase a home-produced car with less than six months' delay, whilst in Switzerland or in practically any other European country one can walk into a showroom and drive away almost any make of British car. For the British buyer, however, unless he can afford the fantastic prices asked for used post-war popular models he might, at the present rate of release under Government control, have to wait up to eight years for delivery.

Our exports are higher than they have ever been. Whereas in 1938 they were 18 per cent of our total production, they are to-day 77 per cent, a figure far greater than that achieved by any other major industry.

Nearly 337,000 cars were produced by British manufacturers during the first eight months of this year, and 84,000 more than during the corresponding period of 1949. Total shipments in this period amounted to nearly 270,000 cars, of which Australia, heading the list as main buyer, took 87,000. Canada came second on the list with 54,000 cars, Sweden with 17,400 third, while U.S.A. has risen to the fifth place with an import of nearly 10,000 cars.

At home the Government have decreed that a specific number of cars (not a percentage of our total production) shall be made available to the British public in any one year. This allows a mere 110,000 cars to be distributed this year, against more than a million genuine orders. At present there are about 2¼ million cars in use, of which no more than 615,000 are post-war models. The balance are at least eleven years old, many of them even fifteen and sixteen years old. Although owners and garages are doing their best to keep these cars in reasonable condition, there are, of course, limits to what can be done, and we are rapidly approaching these limits. Assuming an average car life of seven to ten years, we need about 200,000 cars every year for replacement alone, and it would take the industry at least three years to redress the enormous backlog of orders even if unlimited steel became available.

Most car factories, at the moment, are working only to 80 per cent capacity, because they lack sheet steel for bodies. Steel-making plant under construction at Margam, South Wales, is expected to produce (towards the end of 1951) more than a million tons of sheet steel annually, which should enable a further 150,000 more cars to leave the assembly lines each year. Furthermore, there is news that the "Big Six," Austin, Ford, Nuffield, Rootes and Vauxhall, are to spend well over £50 million in the next twelve months on plant modernisation and factory extensions.

As we have indicated in previous reviews, the industry has been working for the last three years under particularly favourable conditions, induced through the worldwide dollar shortage, the lack of any noticeable competition from the Continent, and, further owing to last year's devaluation of the pound, which has greatly stimulated our export sales to hard currency countries.

It would be unfair to attribute the sustained popularity of British cars only to the fact that they are available abroad and at competitive prices. British cars, to-day, are greatly superior to the pre-war models, which, designed largely for the home market, were badly handicapped in design by an antiquated taxation formula. Since the 1948 Motor Show, which coincided with the change-over period in design of the British motor industry, so many improvements have taken place in design and construction that the manufacturers are justified in their claim that the present products are now thoroughly acceptable all over the world, whatever the local conditions.

The motor industry's struggle against rising costs has not been entirely effective, owing to factors mainly beyond their control. Excessive taxation, increased prices of imported raw materials, as a result of last year's devaluation, and the regrettable fact that our trade unions are still not sufficiently conscious of the importance of high productivity, are likely to cause conditions which will prejudice our ability to compete.

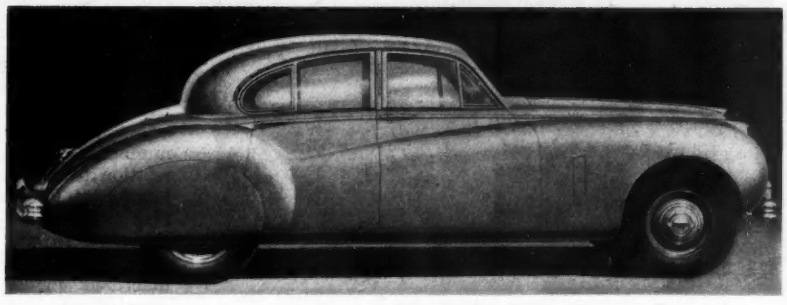


FIG. 2—THE JAGUAR MARK VII

Competition from the Continent has now increased to such an extent that it cannot be neglected any more. The combined total production of France, Germany and Italy, amounting to 436,000 cars in 1949, has been greatly increased, and from statistics now available it is expected to reach the 600,000 mark by the end of this year. Exports from these countries until the end of July, 1950, amounted to 82,000 units (compared with 200,000 British cars), while about 150,000 cars were made available to the domestic markets (approximately 70 per cent, compared with 23 per cent in this country). Continental manufacturers are anxious to provide themselves with alternative outlets abroad and have made particularly marked inroads in European and other countries lacking a motor industry.

In these circumstances the exhibits of this year's Motor Show should be considered not merely from a technical point of view, but with the object of assessing the British motor industry's competitive strength. Excellence in design is not sufficient in itself to stimulate sales, unless backed by economic and competitive manufacturing methods, and it would be wrong to dismiss the conventional in favour of the new so long as the former is likely to remain a marketable proposition. One therefore need not be unduly disturbed by the fact that only a few entirely new British cars are exhibited this year and that no startling or revolutionary changes in design are apparent. It does not necessarily mean that our manufacturers are resting on their laurels, but they can make out a good case for not indulging in bold experiments just now, when there is neither the sales incentive for, nor the financial possibility of, drastically changing their 1948 models. We can be assured, however, that present research will continue to evolve cars well suited to satisfy the demands of our foreign customers.

It was noticeable that the few changes from last year's models made by Austin, Morris, Standard, Rootes and Vauxhall (which repre-

FIG. 1—THE CONSUL—FORD (DAGENHAM)

sent 90 per cent of our total production) are mainly confined to bodywork. There is an open Austin A.40 with a twin-carburettor engine, a Morris Minor four-door saloon, and an open fast touring car made by Triumph and powered by a Standard "Vanguard" engine, which attracted much attention. This car is remarkable for its elaborate system of electro-hydraulic push-button control for adjusting the seats, folding the hood, opening and closing the windows, the bonnet top, the luggage locker and the shutters of the concealed headlamps!

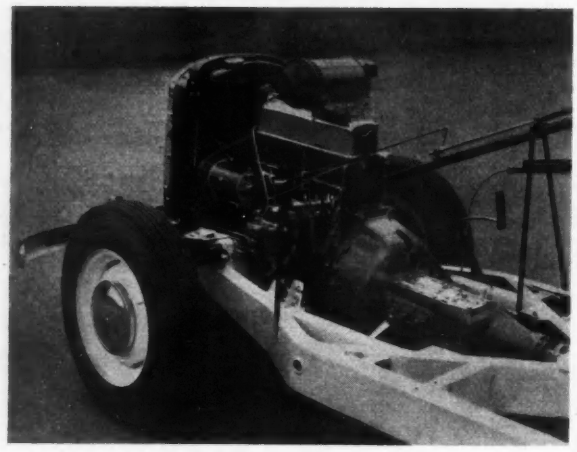


FIG. 3—THE LANCHESTER "FOURTEEN"—DAIMLER

Interest in this year's show however, was mainly concentrated on the presentation of Ford's new cars, the "Consul" and the "Zephyr," the first really modern post-war models to leave the Dagenham works. The "Consul" (Fig. 1) is a four-cylinder car with a 1·5-litre engine, giving 47 b.h.p. at 4400 r.p.m., and the "Zephyr" has a six-cylinder engine of 2·25 litres capacity, producing 67 b.h.p. Both power units have 79·4mm bore and 76·2mm stroke and are therefore the first short-stroke engines built in this country since the Government introduced the flat tax of £10 per year, irrespective of horsepower.

Both cars offer the same body accommodation, but wheelbase and bonnet lengths vary slightly according to the engine fitted, as does the frontal appearance. The bodies, with emphasis on wide windscreens and rear windows, are moderate in height, but with low floor level, and have a tendency towards a squareness of form; the radiator grill is horizontal and the whole design suggests American influence. Excessive ornamentation and superfluous body styling have been avoided, thus resulting in a simple, functional, but æsthetically pleasing form. The power/weight ratio is only about 43 h.p. per ton for the "Consul" and 57 h.p. per ton for the "Zephyr," so that these cars should perform well in any kind of road conditions. Fundamentally, there seems to be nothing novel or unorthodox in the general lay-out of these well-designed models. Nevertheless, we cannot remember any British car, with the exception perhaps of the Vauxhall, at the first appearance of the modern version more than fifty years ago, which embodied so many interesting and ingenious technical details. Integral all-steel body construction of full-track width, back seats well in front of the rear axle, curved windscreen and rear window, independent front-wheel suspension, steering column gear change, and short-stroke engine of adequate capacity are almost a *sine qua non* in the design of a modern mass-produced car, but the way in which practically every one of these various items has been conceived and executed is admirable. It was a pity that there were no exploded models of the various components to give the public an opportunity of appreciating the neatness of design.

Apart from the "Big Six" who control thirteen firms, there were twenty British firms represented at the Motor Show, some of them of quite considerable size and output and enjoying a high reputation as makers of the more expensive type of cars, such as Rolls-Royce, Bentley and Daimler, or specialising in the manufacture of sports cars, such as Jaguar, Aston-Martin, and Lagonda, to name only a few. Although their number seems big in relation to their combined total output, they contribute considerably to our exports. Being manufactured in limited quantities, their design is far more flexible than that of the bigger firms, and we noticed (especially on the stand of Jowett) quite a number of interesting technical details, many of which, although very ingenious as such, would not be entirely suitable for mass production.

One of these cars, the Jaguar Mark VII saloon, attracted much attention. This well-designed and beautifully styled car (Fig. 2) is powered by the well-known 3·5 litre twin camshaft overhead valve engine, developing 155 b.h.p. at 4500 r.p.m., and has already obtained a foothold in the difficult United States market.

The new Lanchester "Fourteen," a striking example of more orthodox construction, is powered by a Daimler-built four-cylinder engine of 2 litres capacity (Fig. 3), developing 60 b.h.p. at 4200 r.p.m. The very rigid frame, comprising box section side members with cruciform bracing, carries a coach-built four-seater body which cleverly combines modern flowing lines with a semblance of the traditional radiator. The independent front-wheel suspension (to be discussed in the second part of this review) was particularly interesting. The adoption of a fluid coupling of the latest open-circuit type in conjunction with an epicyclic gearbox seems unusual for a 2-litre car, but the transmission operates exceedingly well. The car, though not very light (ca. 28 cwt), accelerates very satisfactorily, runs smoothly and should attract many drivers who prefer the preselective gear-change. The car is equipped with Girling hydro-mechanical brakes, i.e., hydraulic brakes for the front and mechanical brakes for the rear wheels. A further valuable item is an automatic lubrication system, which greatly facilitates maintenance.

SOME FOREIGN CARS

Our reference to foreign cars is perforce limited to a mention of those likely to compete in overseas markets.

The main characteristics of American cars are well known and include the usual large roomy body, lavishly equipped and finished, powered by a generously proportioned engine, using low-priced (but high-grade!) petrol, and a fully automatic hydraulic transmission, which is standard equipment on all top-price cars; it can be fitted as an optional extra to almost any of the cheaper models. The hydraulic transmission is far more than a luxury. Although primarily intended for the convenience of the driver in simplifying automobile control, it has proved a strong factor in preventing engine abuse by obviating speeds below 1500 r.p.m., thus reducing the anti-knock requirements of the engine. We feel that no country can hope to enter into direct competition with the Americans in this particular field; our manufacturers have neither the financial resources nor the special plant necessary to make these components at a reasonable price, and it seems that we will have to approach the whole problem of an improved gear change in some different way. It might lead to improved automatic clutches, centrifugally or hydraulically operated, or even back to a simplified version of the system, now dying out in U.S.A., which employs automatic selection of the gear ratios by a control, responsive to engine speed and torque.

FIG. 4—THE HUMBER HAWK

So far the big American concerns have left the development of small and medium-sized cars to their associated companies in other parts of the world. However, two leading independent firms, Kaiser-Frazer and Nash, have models which are competitive. One of them, the Kaiser Henry J., powered with a six-cylinder, 2·6 litre, side valve engine and fitted with a three-speed synchromesh gearbox, sells in America for 1250 dollars, and an alternative model, powered by a four-cylinder Willys engine, will be even cheaper. The Nash "Rambler," one of the few American cars built in integral construction, also has a

side-valve six-cylinder, 2·85 litres engine, and a three-speed Warner gearbox with overdrive. The front wheel suspension, employing individual coil springs, directly acting upon the steering knuckles, is interesting. A consumption of 30 miles per gallon is claimed for the Nash "Rambler," which, integral steel body has door panels, bonnet, luggage compartment and rear wings of aluminium, keeping the dry weight of the car down to about 21 cwt. The independent front wheel suspension, comprising vertical sliding members carrying the stub axles and supported by coil springs, is based on the

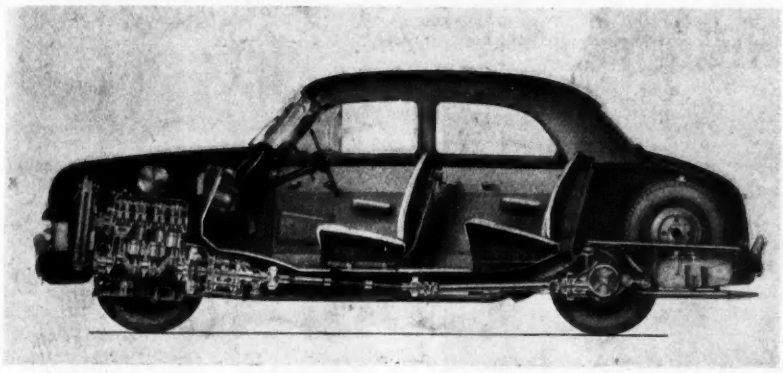


FIG. 4—FIAT "1400"

in view of the high compression ratio, 7·25 to 1, and the light weight of the car, might just be feasible.

Of the French cars, the four-cylinder 1·9 litre and the six-cylinder 2·8 litre Citroen are mechanically still as modern as when first introduced seventeen years ago, although no fundamental changes have been made since. Although very popular in France, their bodies will require drastic restyling if they are to appeal to the Mediterranean and Latin-American markets. The new revolutionary light front wheel drive model, fitted with an air-cooled two-cylinder engine of 325 c.c. capacity, however, was not seen at the Show. At present produced in small numbers only, this model is slowly making its appearance on French roads and the manufacturers are apparently testing the reactions of the public before committing themselves to the cost of tooling up for large-scale production.

The rear-engined Renault with its 750 c.c. water-cooled four-cylinder engine, described in last year's article, is becoming very popular in Europe, mainly because of its outstanding performance and excellent roadholding properties. At the State-owned Renault factory production is expected to reach the 80,000 mark by the end of this year.

Another very advanced small car from Panhard, one of the oldest French factories, is the Dyna, now offered as type 120 with a 745 c.c. engine as an alternative to type 110 with a 610 c.c. unit, which was also described in last year's review. The new air-cooled engine is a flat twin with a compression ratio of 7·5 to 1 and develops 32 b.h.p. at 5000 r.p.m. The car is extremely light and the body is built of aluminium panels on a cast aluminium frame, giving a power-to-weight ratio of 52 b.h.p. per ton.

Among the Italian exhibits were two interesting models, the Lancia "Aurelia" and the Fiat "1400," the former a typical example of what we usually associate with Italian style and design, the latter a rather ingenious mixture of styles and design tendencies and quite aptly described lately as a "light American car of European concept."

The "Aurelia," a fast car of notable stability and roadworthiness, is beautifully styled (though at the expense of headroom and luggage space) and has a six-cylinder 60 deg. vee engine of 1·75 litres capacity, developing 56 b.h.p. at 4000 r.p.m. An

principles employed by Lancia for more than twenty-five years. The rear suspension, also independent, is a modification of the one used in their earlier "Aprilia." It retains the trailing-arm system combined with the swing-axle lay-out as used by Mercedes, Renault and other Continental manufacturers. The clutch and the gearbox have been removed from the engine to the rear of the car, the gearbox forming a single unit with the final bevel drive and the differential; half-shafts with two universal joints transmit the torque from the final drive to the independently sprung rear wheels.

The Fiat "1400" (Fig. 4) is designed for modern mass production methods in Fiat's large Mirafiore factory at Turin. Production is going to be raised to more than 250 units per day, and the car, introduced early this year, is already to be seen in great numbers in Italy and Switzerland, where it sells for about the same price as the 1·7 litre pre-war model of the Mercedes "170 V" and the 2 litre Standard "Vanguard." It is a car which, in international markets, must be considered a serious competitor to our own models. The appearance, weight, overall dimensions, and its general conception are not unlike the new Ford "Consul," having an all-steel integral body of full-track width, independent front wheel suspension with coil springs enclosing telescopic dampers, and a short-stroke four-cylinder, 1·5 litre engine which develops 44 b.h.p. at 4400 r.p.m. It has, however, a four-speed gearbox and, instead of the semi-elliptic springs used by Ford, the rear axle is suspended by coil springs in conjunction with longitudinal leaf thrust springs; a transverse torque rod, connecting the axle casing with the side members of the body, serves as a stabiliser. The transmission, too, is different, as the propeller shaft is subdivided and supported in the middle by a rubber-mounted roller bearing, bolted to the body structure. The first part, a thin torsionally flexible shaft, transmits the torque straight from the output shaft of the gearbox through a rubber coupling to this bearing, and the second part, set at small angle to the first one and leading to the rear axle, is a tubular shaft of ample sectional modulus with two universal joints. This arrangement, of course, requires careful alignment at the assembly, but, with the engine gearbox unit mounted in a slightly inclined position towards the rear it lowers the transmission to such an extent that the floor of the car is practically plane. We had the opportunity of driving two of the new Fiat models on difficult Alpine roads and can testify that the general performance of the car, especially the roadholding, springing and steering, and the flexibility and smoothness of the engine and transmission are excellent.

(To be continued)

Water Pollution Research

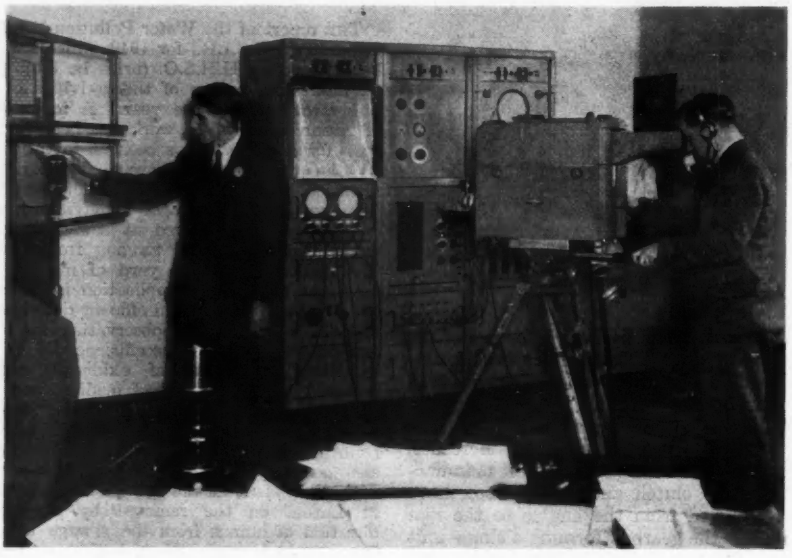
THE report of the Water Pollution Research Laboratory, D.S.I.R., for 1949, which has just been issued by H.M.S.O. (price 1s. 6d.), gives an interesting review of the activities of the Laboratory during the year. A major item of research, on which work has been in progress for some years, has been an investigation on the treatment of sewage by biological filtration. Experiments with a pilot plant have been carried out at rates much higher than are commonly employed at sewage disposal works, the rates tried ranging from 100 to 1000 gallons per cubic yard of medium per day. As the rate of application is increased the quality of the treated effluent deteriorates, but the most striking observation from the experiments was that the efficiency of a filter, expressed as weight of oxidisable matter removed per cubic yard of medium per day, increased almost linearly with the rate of application, there being little interference from ponding at the higher rates. The report also contains further results of experiments with pilot plant at the sewage disposal works at Luton, on the removal by mechanical filtration of humus from the sewage effluent. Two methods were tried, both successfully, the first consisting of filtration in pressure and open rapid gravity filters and the second of micro-straining in plant developed by Glenfield and Kennedy, Ltd. Other work described deals with the treatment of sewage containing spent gas liquor, control of nuisance from filter flies and the effects of various methods of treatment on the numbers and types of bacteria in sewage, and the treatment by biological processes of waste waters from the manufacture of special types of paper, mainly from rag and hemp. The Laboratory has also started a survey of the Thames Estuary, on behalf of the P.L.A., to examine the causes of silting. An interesting work was also undertaken for some time in Tehran. The city's water supply is taken from the River Karaj, the water of which varies widely in character during the year. After testing various methods of treatment, it was recommended that the raw water, after sedimentation of coarse suspended matter at the intake, should be treated by addition of ferric chloride, sedimentation, rapid filtration through sand and sterilisation.

The Engineers' Guild

THE General Council of the Engineers' Guild has elected Mr. Robert Chalmers, M.I.C.E., M.I.Mech.E., as the first President of the Guild. From its beginning just prior to the war, Mr. Chalmers has been closely associated with the development of the Guild and for the first ten years of its existence he was Chairman of the General Council. For the past twenty years Mr. Chalmers has been on the staff of the London County Council, and has recently retired from the position of senior divisional engineer in the chief engineer's department. Mr. Henry Nimmo, M.I.C.E., M.I.Mech.E., M.I.E.E., has been elected Chairman of the Guild's General Council. He is Chairman of the Southern Electricity Board, and prior to taking up that appointment in January, 1948, was an Electricity Commissioner. Mr. W. S. Graff-Baker, A.C.G.I., M.I.Mech.E., Chief Mechanical Engineer (Railways), London Transport, has become Vice-Chairman of the General Council.

A Demonstration of Outdoor Air-Blast Circuit Breakers

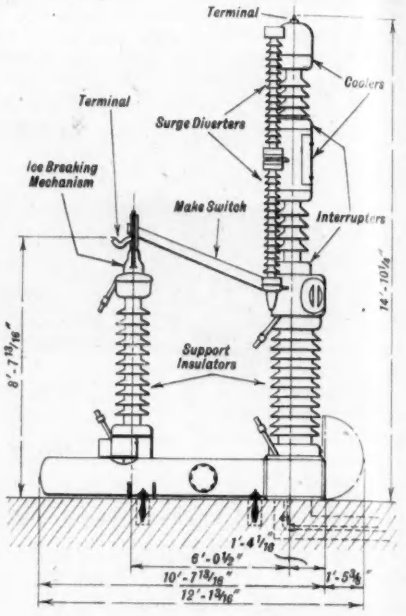
ON November 2nd, we witnessed a series of tests designed to demonstrate the performance of high-voltage, outdoor, air-blast circuit breakers manufactured by the English Electric Company, Ltd. The demonstration, which was made in the company's Nelson Research Laboratories, Stafford, included lectures outlining the development of the circuit breakers, and was attended by a number of consulting engineers and British and French electricity supply engineers.



TELEVISION CAMERA IN SWITCHGEAR TEST CONTROL ROOM

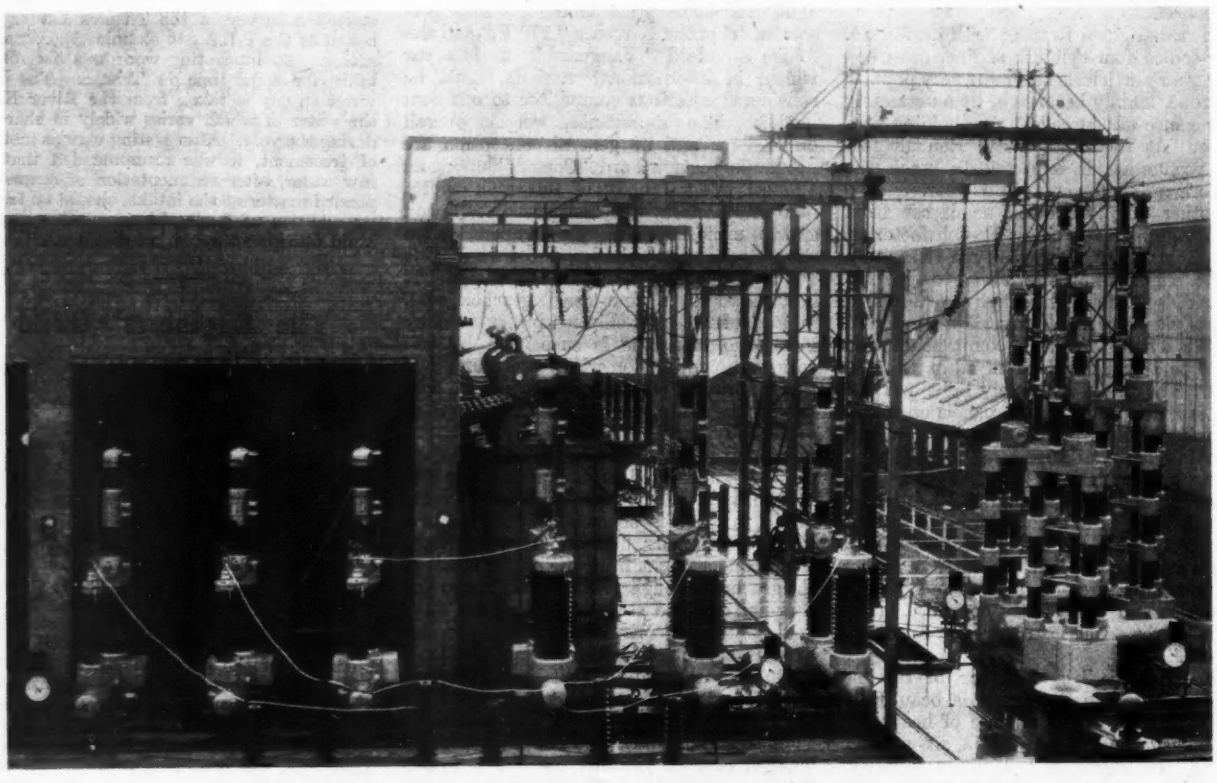
Vivid presentation of the tests was made possible by the use of four Marconi television transmitters and a number of receivers conveniently placed in an observation room overlooking the test area, so that the spectators could see close-up views of the test circuit-breakers and oscillographic records and explanatory diagrams displayed in the switchgear test control room, as illustrated herewith. Viewers could also see, in safety, the effect of short-circuit stresses on the end turns of the high-power test generator.

Four circuit breakers, having the following ratings, were demonstrated:—2500MVA at 132kV, 3500MVA at 165kV, 7500MVA at 275kV, and 10,000MVA at 400kV. Reading from left to right, these equipments are shown in one of the accompanying illustrations. It will be observed that the 132kV and 165kV equipments consist of complete three-phase-circuit breakers, while each of the other equipments is a single-pole element. The general arrangement of the 132kV circuit breaker is shown in the accompanying outline drawing.



OUTLINE OF 132KV CIRCUIT BREAKER

The whole range of circuit breakers is based on the use of two or more identical interrupters, the original of which was designed for the company's 66kV breaker and has given satisfactory service over eight years. The interrupter is a standard unit, common to the whole range, and the higher voltages and ratings are catered



RANGE OF OUTDOOR AIR BLAST CIRCUIT BREAKERS

for by increasing the number of units in series, using, for example, two interrupters per phase at 132kV, 2500MVA; three interrupters per phase at 165kV, 3500MVA; six interrupters

REMOVAL OF INTERRUPTER CONTACTS

per phase at 275kV, 7500MVA, and eight interrupters per phase at 400kV, 10,000MVA.

Each interrupter consists of a butt type moving contact sealing off a throat in the fixed contact, and is mounted in a unit assembly, as well as forming one outgoing terminal. The interrupters are so arranged that the moving contact can be withdrawn through doors provided in the side of the base castings without disturbing the insulators. This arrangement simplifies inspection and maintenance, as shown in one of our illustrations.

275kV Circuit Breaker

Bearing in mind that the interrupter is common to all the circuit breakers, a short description of the 275kV single-pole unit will serve to indicate the general design characteristics of the complete range.

Each phase of the 275kV circuit breaker consists of two identical halves, each comprising an air receiver and three interrupters in series. The two halves are joined by a double-blade make-switch, which connects the six interrupters electrically in series, to form one complete pole of the breaker.

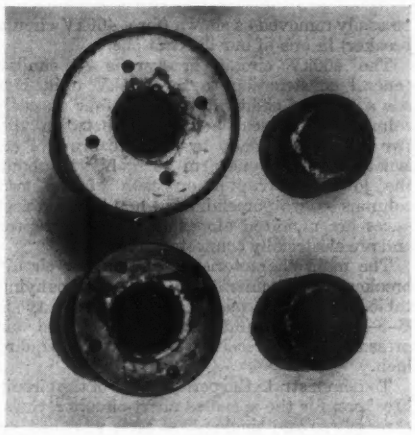
The interrupters and make-switch driving equipment are mounted on porcelain base insulators built up of easily handled sections in tripod formation, constituting a stable construction, in which the three legs of the tripod are stayed together by the top casting and at two intermediate points. The tripod legs are also used for the auxiliary switch mechanical drives and for conveying air to the make-switch operating cylinders. In addition a central insulator column of larger internal diameter is provided to act as the main air column for the air required for circuit interruption.

Compressed air for operation of the circuit breaker is supplied from main air reservoirs on which are mounted three-stage compressors together with automatic pressure-operated relays for controlling the motors, an automatic reducing valve for reducing the air pressure to the value used in the circuit breaker receivers and the necessary filter and stop valves, &c.

The local air receivers are forged drawn drums (two per pole), mounted at the base of the circuit breaker, between the two sets of tripods and, being independent of the interrupter columns, are easily accessible for inspection, as required by factory regulations. The main blast valves are fitted on the sides of the receivers at the base of the main air column so as to be removable without disturbing any insulators.

High-speed, electrically operated, pneumatic valves control the blast valves, and, on opening, pass high-pressure air up the centre insulator posts to the interrupters. A proportion of the air flows to each interrupter through the passages provided and forces the moving contacts down, thus drawing an arc in each of the interrupter throats. These arcs are extinguished by the cooling and scavenging effect of the compressed air which takes the arc products with it into the coolers. A special arcing probe is provided to carry the arc during the short period of arcing and thus protect the current-carrying surfaces.

A non-linear resistance is electrically connected across each interrupter. This resistance serves two purposes: first, it equalises the voltage across the six interrupters, thus ensuring that the duty is equally shared between them, and, secondly, it damps the peak restriking voltage transients. Immediately following the interruption of the arc the make-switch arms



INTERRUPTER CONTACTS AFTER TESTS

are operated by means of air engines installed in the lower interrupter casting.

The circuit breaker is closed by a second air engine which drives home the make-switch, the contacts of which are specially designed for making against the peak fault current. Ice-breaking arrangements are incorporated on the make-switch blades.

The circuit breakers are inherently suitable for high-speed automatic reclosing, which is accomplished by holding the interrupter contacts open by the flow of compressed air, for the predetermined dead time, and then allowing them to reclose and remake the circuit without operation of the make-switch. If the fault still persists, the breaker opens in the normal way as described above and locks out.

The control valves, terminal boards, multicore glands, &c., actually on the breaker are mounted in weatherproof cabinets attached to the side of the breaker base and are thus readily accessible for inspection and maintenance.

For maintenance a steel ladder and davit

Three-Phase Short-Circuit Tests on One Pole of a "OBR" Circuit Breaker

Test cycle	Initial values			Final values							Times			
		Making current		Breaking current				Recovery voltage		Three-phase symmetrical breaking, MVA	Duration of short to contacts part, 1/100 sec.	Arc duration, 1/100 sec.	Opening time, 1/100 sec.	Total break time, 1/100 sec.
	Applied line voltage, r.m.s. kV	Major peak, kA	Symmetrical, r.m.s. kA	Symmetrical		Asymmetrical, r.m.s. kA	D.C. component, per cent	Phase, r.m.s. kV	Average, r.m.s. kV					
				Phase, r.m.s. kA	Average, r.m.s. kA									
B	39·5	22·2 29·8 32·1	15·3 15·8 15·3	13·4 13·1 13·6	13·4	13·4 13·2 13·7	0 3 3	34·3 34·1	34·2	793	4·7	2·8 2·8 1·2	5·6	8·4
3–B	39·7	33·4 25·1 34·9	15·1 15·4 15·5	13·5 14·0 14·1	13·9	13·5 14·0 14·1	2 0 2	34·3 35·6	34·9	840	4·0	1·9 1·3 1·9	5·5	7·4
3–B	40·0	24·7 32·4 31·5	15·5 15·0 15·6	13·7 13·8 14·0	13·8	13·7 13·9 14·1	1 5 3	34·6 34·9	34·7	827	4·1	2·1 2·1 1·5	5·4	7·5
B	38·4	32·8 32·6 21·2	14·0 13·2 13·6	13·3 13·0 13·4	13·2	17·3 15·6 13·5	58 47 10	39·8 34·9	34·9	797	2·2	2·0 1·5 2·0	5·6	7·6
3–B	38·4	20·7 34·7 36·4	13·5 14·2 13·6	13·1 12·9 13·2	13·1	13·1 16·8 17·3	5 59 60	34·4 34·1	34·3	777	2·3	1·8 1·8 1·4	5·5	7·3
3–B	38·4	35·0 23·5 37·4	13·1 13·8 14·0	13·1 13·6 14·0	13·6	16·4 14·2 19·7	53 20 70	35·5 36·0	35·8	842	2·2	2·1 2·1 1·7	5·5	7·6

is provided which can be fixed to the side of the breaker so as to give ready access to the interrupters. A set of interrupter contacts can be easily removed as shown (for a 400kV circuit breaker) in one of our illustrations.

Main Characteristics of Air Blast Circuit Breakers

Type	"OBN–8g"	"OBP–9g"	"OBR–11k"	"OBS–12k"
Service voltage, kV	132	165	275	400
Symmetrical breaking capacity, kA	10·9	12·3	15·8	14·4
Equivalent to, MVA	2,500	3,500	7,500	10,000
Asymmetrical breaking capacity, kA	13·4	15·1	19·4	17·7
Making capacity, kA peak	27·8	31·4	40·2	36·6
Normal current, A	600	600	800	800

The 400kV circuit breaker is of similar general construction to the 275kV unit, but has a total of eight interrupters, four on each column. Electrical connection between the two columns is made by the two arms of an isolating switch, one arm being hinged about the lower interrupter on each of the two columns. Two porcelain-clad non-linear resistances are mounted alongside each interrupter and are electrically connected across it.

The main characteristics of the four circuit breakers are summarised in the accompanying table. In each case the operating duty is B–3–MB–3–MB, and the normal initial air pressure in the receiver is 300 lb per square inch.

To demonstrate the performance of the circuit breakers, for the specified short-circuit ratings, three-phase and single-phase tests were carried out on each equipment. The tests, which were generally in accordance with B.S. 116, Part II, 1937, were done on one or more interrupters at various values between 1 and 100 per cent of the specified short-circuit ratings.

The circuit breakers were subjected individually to no-load timing tests, with each pole connected in a low-voltage d.c. circuit. All the circuit breakers were connected effectively in series, selection of the appropriate unit for test being made by a switch in the control room. An electromagnetic oscillograph recorded the relevant electrical quantities and timing traces during the tests.

A potential transformer, connected between the line terminal of the pole and earth, was used to measure the voltage on each pole of the circuit breakers. Currents were measured by current transformers in the line side of each phase.

Power for the tests was taken from the short-circuit testing alternator in the high-power laboratory, a step-up transformer providing the necessary test voltages. In all the tests the alternator was star connected; for the three-phase tests the transformer was delta connected, and, for the single-phase tests the mid-point of the transformer was earthed. A potential transformer was used in the measurement of the alternator terminal voltage, and the currents in the closing and trip coils were measured by non-inductive shunts.

For all the tests each circuit breaker was supplied with high-pressure air from its own receiver, through blast valves mounted at the base of each column. Operation of the circuit breaker under test was initiated through electro-pneumatic control valves. All the tests were made with an initial pressure of 270 lb per square inch, that is, the minimum pressure below which lock-out occurs.

The table on p.473 (which is typical of the tests performed) records the performance of the 275kV circuit breaker during three-phase short-circuit tests at 38kV; the first three tests are for a symmetrical breaking capacity of 15·2kA, r.m.s., and the second three tests for an asymmetrical breaking capacity of 18·6kA. Each group of tests was made only on the top and middle gaps of one column in series. The power factor in the first three tests was 0·2 and in the remainder was 0·05. The phase values were recorded in the order R, Y, B throughout. The operation was satisfactory in each test; in the first three tests there was slight gas emission from the coolers; in the fourth and fifth tests the gas emission was moderate; in the sixth test there was moderate gas emission accompanied by slight flame.

One of our illustrations shows the general appearance of the fixed and moving contacts after the tests. In both interrupters the moving contacts suffered moderate burning of the tip, face and seating; the face and seating of the fixed contacts were slightly burnt, while the probe was burnt back $\frac{1}{8}$ to $\frac{3}{16}$ of an inch.

American Engineering News

Portland Cement Association Laboratories

THE opening took place recently of the new research and development laboratories of the Portland Cement Association at Skokie, Illinois, on the outskirts of Chicago. The Portland Cement Association is an organisation devoted to scientific research, technical service and engineering field work, and is supported by over sixty member companies which produce a major proportion of the Portland cement used in the United States and Canada. The new laboratories will provide additional space and improved facilities for the expanding research and development work undertaken. The two new buildings, are connected by a covered path and have a total floor area of 98,000 square feet. The new grounds occupy an area of 15 acres, providing ample space for outdoor experimentation, storage and exposure testing. The auxiliary building is used to house all the noisier and dirtier operations. Thus, in this building are situated the cement and materials storage, the industrial processes laboratory, the aggregate storage and processing room, the soil processing laboratory and utility and maintenance services. The industrial processes laboratory will be used for wet and dry grinding, clinker burning, steam curing, production of lightweight aggregates and similar projects. A dust collector system mounted in the roof and having a capacity of 9600 cubic feet per minute serves this room as well as the room for aggregate storage and processing. The latter room has a radiant heat floor for drying the aggregate prior to screening. A boiler room contains equipment to supply heating, refrigerating, compressed air, vacuum, steam and hot water services to both the buildings.

Concrete materials are taken by hand truck at ground level from the auxiliary building to the main building. Here a lift takes them to the first floor for immediate study or to the basement for making up concrete specimens. Concrete is made in the batching room, and specimens are produced in the concrete laboratory, which has a temperature of 73·4 deg. Fah., maintained within plus or minus 3 deg. Fah., and a relative humidity of 50 per cent, and finally the specimens are cured in the saturated atmosphere of an adjacent moist room. For physical testing purposes there are a 1,000,000 lb compression machine and a 400,000 lb universal machine situated in the main testing laboratory extending over three storeys. These machines are supplemented by five smaller units, varying in capacity from 20,000 lb to 330,000 lb in compression. The large machine was specially designed for the testing of large reinforced concrete members, being able to deal with lengths of 30ft, widths of 10ft and heights of 15ft. The laboratory is equipped with a 15-ton crane for the handling of large specimens. Other laboratories situated on the two floors of the main building are mainly devoted to analytical chemistry, physical chemistry and physics and contain conventional equipment. With regard to the buildings themselves, boring tests indicated poor foundation conditions, and it was decided, while using spread footings for the single-storey auxiliary building, to use concrete piles for the main building. The piles averaged 35ft in length for an indicated bearing capacity of 30 tons. Twenty-seven piles were used for the machine foundation for the 1,000,000 lb testing machine. This is completely separated from the building foundation proper and contains 262 cubic yards of concrete.

Cachuma Dam in Southern California

The U.S. Bureau of Reclamation has authorised the construction of Cachuma Dam on the Santa Ynez River in southern California. This earth-fill structure is part of the project designed to augment the water supply for the city of Santa Barbara and to irrigate 29,650 acres of land in Santa Barbara county. Cachuma Dam and reservoir will provide storage capacity for 210,000 acre-feet of excess seasonal water from the Santa Ynez River. Surplus water not required by water users in the Santa Ynez Valley will be diverted to the south coast area surrounding the city of Santa Barbara through a 6 mile tunnel and a 28 mile conduit now under construction. The Cachuma Dam will be 2975ft long at the crest and will have a height of 275ft from foundations. Approximately two-and-a-half years will be required for the completion of the dam.

Cut in Public Works

A cutting down of public works projects, which do not contribute to national defence, has been necessitated by the international situation. The Secretary of the Interior has laid down the following rules to apply to Federal water and power projects. Work will continue on all power project construction, except where power output would be slight and incidental to other functions. Work will be continued on projects for municipal and industrial water supplies. All small projects which can be completed this year or in the next working season will be continued. That part of the work on any project which will provide water for irrigation by July 1, 1952, will be continued. Any other authorised work for which funds are available will continue if the work is justified on the basis of contribution to economic development or food production. General investigations, operation and maintenance programmes will proceed, as they are considered essential to national security. All other work will be discontinued and not resumed until changed conditions prevail.

British Engineers' Association

ON Thursday, November 9th, the British Engineers' Association held a luncheon at the May Fair Hotel, London. Mr. Keith Fraser, the President of the Association, who took the chair, proposed the toast of "The Guests." The Hon. Eric J. Harrison, Resident Minister in London of the Commonwealth of Australia, replied in a speech in which he reviewed the resources of Australia. He pointed out that it was planned to produce 3 million tons annually of steel in that Continent by 1957. He mentioned the great schemes such as the Snowy River scheme for hydro-electric and irrigational development. Mr. Harrison felt that the total resources of the Commonwealth were so great that if they were properly developed the Commonwealth could become the most powerful nation in the world. But it would be necessary to have an equal and balanced development, and he felt that the planning should be in the hands of some form of "Commonwealth Council." Sir Percivale Liesching, Permanent Under-Secretary of State of the Commonwealth Relations Office, also replied shortly to this toast. When the President had replied to a "Vote of Thanks," proposed by Mr. D. D. Walker, proceedings came to an end.

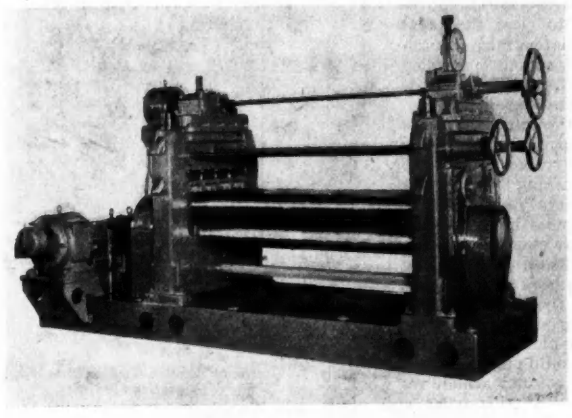
A PORTABLE ELECTRIC HAMMER KIT.—Wolf Electric Tools, Ltd., has introduced a new building and maintenance electric hammer kit based on its portable electric hammer. The kit, which includes "Rawldrills," stone mason's chisels, scaling chisels, &c., is fitted into a strong steel case designed for easy handling and carrying.

A Plate Levelling Machine

We reproduce below an improved seven-roll plate levelling machine, which is now being built by the Bronx Engineering Company, Ltd., of Lye, near Stourbridge, for handling mild steel plates up to 6ft wide and ¼in thick at a speed of about 25ft per minute.

The machine is mounted on a heavy, rigid base, the main frame being of cast iron box section, with loose housing caps secured by tie bolts. Its seven straightening rolls, of 45/50 per cent carbon steel, are carried in bronze lined bearings. The three bottom rolls and the four top rolls are each 8in diameter. All of the bottom rolls are driven, the top rolls being idle and provided with means of adjustment to suit the material being handled. Adjustments are made simultaneously to all the top rolls through a 5 h.p. motor mounted on the left-hand housing, and the two outer top rolls are provided with separate handwheel adjustment through which they can be set to bring the material out of the machine in a flat condition.

A 20 h.p. motor rigidly mounted on an extension at the base of the machine, drives the bottom rolls through a reduction unit and a train of machine cut double-helical gears.



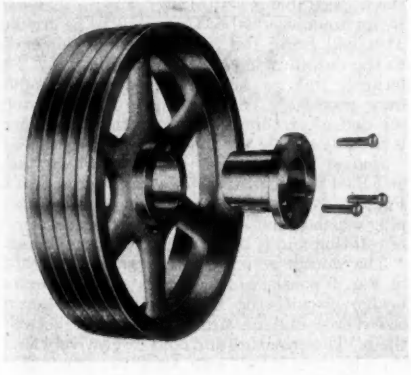
SEVEN-ROLL PLATE LEVELLING MACHINE

Adaptor Bushed Pulleys

A recent addition to the power transmission equipment made by Crofts (Bradford), Ltd., of Bradford, is a useful range of adaptor bushed vee-rope pulleys of the flange bush type. These new pulleys are designed to cover a range of the company's standard vee-groove pulleys for vee-ropes of ¼in, ⅜in, ½in and 1¼in section in various pitch circle diameters. They are made for speed ratios from 1 to 1 up to 7½ to 1 and are both single and multiple grooved for transmitting up to 150 h.p.

We reproduce herewith a photograph showing clearly the design of one of the new pulleys. The pulleys are bored to standard sizes with taper holes; and adaptor bushes, bored to suit various shaft diameters, are turned with corresponding tapers to the pulleys. Each bush has a keyway in its bore to transmit the drive to or from the shaft, and a feather fitted to the outside diameter mates with a keyway in its pulley. A horizontal slot is milled through the length of the bush hub and flange and three setscrews passing through the flange are used to assemble the unit on a shaft.

When fitting the assembly on a shaft the bush is placed in position and then the action of pulling the pulley on to it by means of the setscrews fixes both pulley and bush firmly in position. When it is required to remove a pulley from a shaft the setscrews are removed and two of them are then screwed into tapped holes in the bush flange. The action of screwing in these two screws jacks the pulley free of the hub and parts can then be easily removed.



ADAPTOR BUSHED VEE-ROPE PULLEY

A Cable Tightening Tool

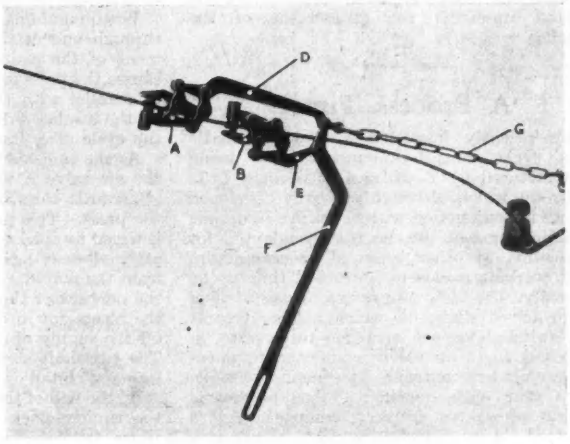
A useful tool for cable tightening purposes, which is being made by A. B. Bofors, of Sweden, has a variety of applications for stretching cable and telephone lines between poles, pole erection, guy line tensioning, &c. The tool, which is marketed in this country by Asea Electric, Ltd., Fulbourne Road, London, E.17, is shown in operation, tightening a power cable, in the accompanying illustration.

The tool consists of two sets of clamps, *A* and *B*, the jaws of which are actuated by links to close on the cable through the levers *D* and *E* pivotally mounted on the handle lever *F*. The hand lever is anchored at its uppermost point by means of a chain *G*.

In tensioning a cable, when the handle is moved forwards towards the line of cable to be tensioned the links of the jaws of the outer clamp *A* are actuated by the lever *D* to close the jaws on the cable and to take the pull or weight of the cable. The same movement frees the jaws of the inner clamp *B* and slides it forwards along the cable. As the hand lever is then pulled back by the operator, the torsion lever *E* first draws on the jaw links of the clamp *B* to close the jaws and grip the cable. At the same time the lever *D* moves forwards to open the jaws of clamp *A*. Continued rearwards movement of the hand lever applies a tensioning load on the cable, which slides through the jaws of the outer clamp. At the end of the tensioning stroke the hand lever is moved forwards again to close the jaws of clamp *A*, which holds the load on the cable as clamp *B* is released and moved forwards. In this manner as the hand lever is moved backwards and forwards the cable is drawn in towards the anchor point of the tool until the required load is applied on the line.

In front of each set of clamps is a spring-loaded friction pad and an anvil between which the cable is guided. These units are designed to fully open each set of jaws as the clamp slides along the cable and serve to reduce friction and consequent wear on the teeth of the clamp jaws. At the side of each jaw are guide fingers, which keep the clamps in line on the cable.

These tensioning tools are made in various models for cables from 3/64in to 35/64in diameter and weigh 7 lb each. It is stated by the makers that without extending the lever of a tool a man can apply a load of up to 2200 lb on a cable and, with an extended handle, he can apply up to 6395 lb. The jaws are designed to hold a cable with a tension load of some 8400 lb.



CABLE TIGHTENING TOOL IN USE

A Toggle-Operated Lever Box

A new lever box for railway switch operation, which has recently been introduced by Thomas Summerson and Sons, Ltd., of Darlington, is illustrated below. The box is designed for ease of operation and can be fitted, without adjustment, to all travels of switches from 2½in to 5½in.

Known as the "David," the new unit is of all-steel construction, built up forgings, bar stock and pressings, all parts being jig built to facilitate interchangeability. The makers state that the design and construction of the box is such that it is virtually impossible to "gag" and the high closing pressure exerted on the tongue rail ensures freedom from "split" switches.

The unit is operated through a powerful

TOGGLE-OPERATED LEVER BOX

toggle spring and the force necessary to overcome the spring when throwing a switch is reduced by a toothed rack gearing. The leverage operates only during that part of the movement in which resistance of the spring is being met, i.e., until the dead centre of the movement of the toggle is reached. At that point an automatic change of fulcrum takes place, which serves to reduce the leverage in the second half of the movement. For very heavy spring switches tandem springs can be fitted and these springs can be adjusted to suit the angle of turnout.

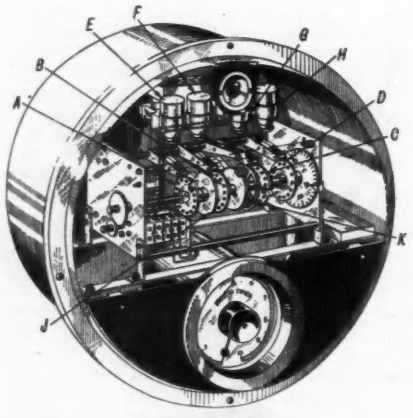
The box accommodates itself to "spread" switches and can be removed from the sleepers without upsetting the adjustment of the switches.

A Process Timer

We recently inspected a new automatic work cycle control apparatus, now being manufactured by T. H. and J. Daniels, Ltd., of Stroud, which, although primarily developed for use in conjunction with the firm's hydraulic moulding presses, can be readily adapted for application to other types of process equipment working a closely controlled time cycle. Basically, the new apparatus consists of a motor-driven shaft, on which a line of cams and switchplates are arranged to operate, in sequence, small air valves connected to pneumatic cylinders controlling the main hydraulic valve gear on a machine. This automatic control apparatus is very compact and is mounted in a circular housing some 15in diameter by 7in deep. It can be incorporated in the structure of a press or supplied on a pedestal mounting for installation at some distance from a machine.

The layout of one of the controllers arranged for use with a plastic moulding press can be seen in the drawing below. With reference to this drawing, the operating cycle can readily be followed.

The camshaft is driven by a synchronous motor through a gear train designed to rotate the shaft at 2 r.p.m. in the standard equipment. The gear train can be changed to give



PROCESS TIMER

other speeds if required. A time cycle control clock in the lower part of the case is coupled to the electric circuit of the apparatus. Mounted on the camshaft are four metal discs, *A*, *B*, *C*, *D*, each of which has a ring of holes drilled round its outer circumference for the attachment of cam lobes. Through rocker arms these cam lobes operate the pistons of air valves *E*, *F*, *G*, *H*. Each of the air valves is coupled to an air cylinder on the hydraulic valve control gear of the press and through them all movements of the press are controlled.

Opening movements of the main ram of the press are controlled by the position of the lobes on the disc *A* and its closing movements by disc *B*. Upwards movements of the press ejector or transfer ram are controlled by the disc *C* and downwards movements by disc *D*.

Two insulated discs, *J* and *K*, on the camshaft, have recesses cut in their peripheries and are arranged to actuate spring-loaded contact switches. The contact actuated by the first disc *J* switches the camshaft motor on and off and is wired in parallel with a limit switch on the press. Contacts actuated by the second disc *K* control the camshaft motor and operate a clutch in the process clock.

The camshaft is prevented from rotating in the wrong direction by a ratchet wheel. A dial at the extreme end of the shaft is graduated in thirty divisions, each equal to a time step of one second on a 2 r.p.m. shaft, or proportional times when the shaft is geared to run at a different speed. This dial is used to facilitate precise setting of cycle timing.

When moulding in a hydraulic press operated through one of these units, the initial movement of the control valve to close the press causes the press table to actuate a micro-switch in parallel with the contact switch controlled by the insulated disc *J*, and from then onwards the cycle of operations is fully automatic.

As the camshaft rotates, the cam *A* actuates the air valve *E* to open the press and shortly afterwards cam *B* actuates valve *F* to close the press. This press "breathing" movement is timed to open the press slightly and immediately close it again after gases have escaped from the mould. In the next stage of rotation the contact of the insulated disc *J* drops into the recess cut in disc's periphery and switches off the supply of current to the driving motor. The camshaft stops rotating and at the same time the clutch of the timing clock is energised.

At the end of the preset mould-curing period, the timing clock makes a contact which restarts the camshaft motor. At this point a second contact drops into the recess in the disc *J* to maintain the supply of current to the motor after the contacts made by the timing clock have been broken. The clock is then automatically reset, ready for the next cycle of operations. A second cam lobe on the disc *A* actuates the air valve to open the press and at the end of the opening operation the cam disc *C* operates its valve *G*, which is connected to the press ejector. The ejector moves up to eject the moulding from the press and is returned by the action of the fourth cam disc *D* when it contacts the air valve *H*.

After the ejection operation the camshaft continues to rotate until the contactor of the switch actuated by the insulated disc *J* drops into the recess and the current is cut off.

Form Grinding by Mechanical and Optical Methods*

By E. A. COOKE, A.M.I.Mech.E.†

No. II—(*Continued from page 446, Nov. 10th*)

Principles of Circular-Arc Generating

Consider a disc upon which three points *Z*, *Y* and *X* respectively are located, as shown in Fig. 7. If any of these points is used as a centre of rotation, the others will rotate around it and will then represent points in a circular path. In this case the angle θ will change its value in accordance with the angle through which the disc is rotated, *PP* being the plane of reference as in the gyratory method. The argument is still applicable if more than one disc is used, if they are suitably coupled.

Points *Z*, *Y* and *X* respectively may also be constrained to describe circular paths without change in the value of θ, as in the translatory method.

A feature of translatory grinding is that the point at which grinding takes place is distributed around the wheel-edge radius in direct proportion to the angle subtended by the arc to be ground. This is clearly shown in Fig. 8*a* and *b*, which also shows why, in setting up the machine, allowance must be made for the wheel-edge radius. When this method is used shaft *B* is freed from its drum, which is then locked against rotation; at all other times the shaft and drum rotate as a unit.

The optical scales are used to identify and locate salient points such as centres of rotation, which are fixed in space by the radius arm and linkage, while the wheel is maintained tangential to the graticule of the wheel microscope; grinding will therefore always take place in this plane—equivalent to the centre of the viewing screen—and allowance must be made for this fact in setting the machine. A great advantage of this practice is that to compensate for wheel wear the grinding wheel need only be fed forward to maintain tangency with the optical reference.

Method of Setting Co-ordinates.—Assuming that the zero position of the tables has already been carefully checked—that is, the mechanical

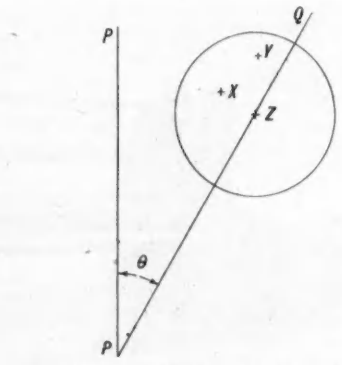


FIG. 7—*Centres of Rotation Used in Circular-Arc Generating*

axes of *A* and *C* are coincident with the optical axes of the projection system and the work microscope—the first step is to fix the locating linkage and free the sliding member on the radius arm. Co-ordinates may be set in any order by operation of the large handwheel. The first digit is obtained from the grid, the second from the fixed scale, and the third and fourth digits from the inclined scale.

The sliding member is then fixed and the linkage is freed so that the *Y* reading on the screen can be cancelled by setting back the carriage. The *X* reading is also cancelled after

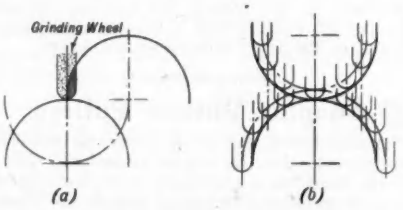


FIG. 8—*The Effect of the Wheel-Edge Radius When Using the Translatory Method*

fixing the spigot of the radius arm; in addition, the upper table is set to the right of the datum by an amount equal to the radius to be ground. This will bring the finished radius tangential to the datum plane as shown in Fig. 13*b*. The locating linkage is again fixed and grinding may proceed. That applies to the gyratory method of grinding, but the setting procedure is broadly similar for the translatory method.

Radius Arm.—This consists of an arm attached to *B* by means of a flange as shown in Fig. 9. Adjustable along its length is a sliding plug which is first set co-axial with a new centre of rotation and is then anchored by the linkage.

The double-acting electric gauge illustrated in Fig. 9 consists of two coils of an inductive bridge circuit—the other coils being housed elsewhere—and an armature located between them. The armature and coils respectively abut, through couplings, with arms mounted upon frictionless pivots so that pressure upon either end of the operating rod will produce movement of one with respect to the other. The unbalanced current produced is then indicated upon a suitable meter and used in conjunction with standard gauge blocks for linear displacement, to supplement the optical scales when using the translatory method. Angular

* Institution of Mechanical Engineers, October 27th. Abstracts.

† Head of mechanical development, Taylor, Taylor and Hobson, Ltd.

measurements are made with the large-diameter protractor.

Another feature is the compound slide, for use when it is required to generate a straight-line tangential to a radius just completed, without further setting, and with perfect blending. The basis of this feature is that the tangent to the curve will always be normal to the radial line at the limit of the angle subtended by the curve.

Principles of Involute Generating.—The mechanism provided for this purpose must be an attachment which can be substituted for the radius arm previously described.

Fig. 10 shows the geometry of the attachment. It consists of a base plate or link mounted upon a disc of diameter equal to the maximum base circle and connected to a similar disc, at the opposite end of the link, by a steel band. A lever is pivoted in a line intersecting the axes of the two discs.

A sliding member is attached to the pivoted link, the point of attachment being variable along the link. Rotation of the base plate about O will produce an angular displacement of the reducing link and, in turn, a linear displacement of the sliding member; thus the point A will evaluate the involute function $\frac{\pi r\theta}{180}$. The practical interpretation of this is shown in diagrammatic form by Fig. 11, in which two slides supersede the second disc. The base circle radius is adjusted by screw C, and an electric gauge (not shown) is included for use in conjunction with standard gauge blocks in a manner similar to that previously described in connection with the radius attachment. In use the flange is coupled to shaft B of the machine and is engaged by the spigot of the adjustable linkage.

If A maintains a constant position, movement will be transferred to shaft B and through the carriages to work table A and reference shaft C. A photographic illustration is shown in Fig. 12.

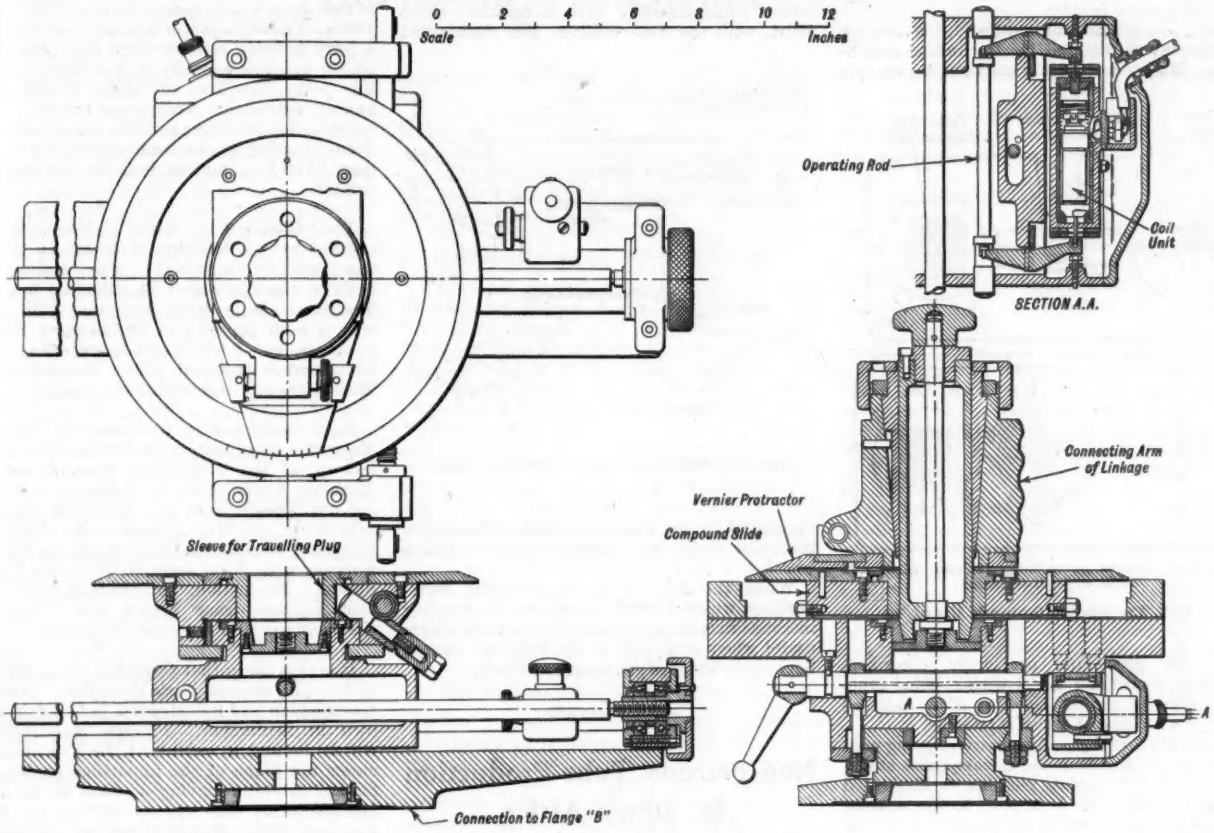


FIG. 9—*Attachment Used for Generating Circular Arcs*

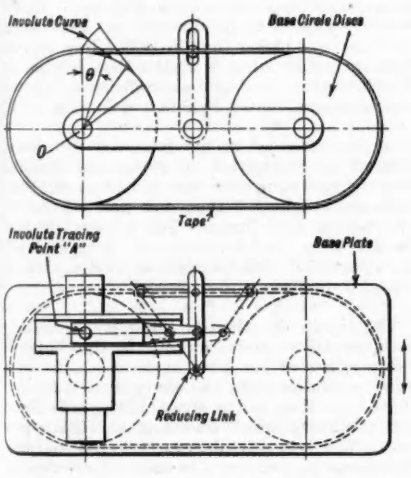


FIG. 10—*Geometry of Attachment for Involute Generating*

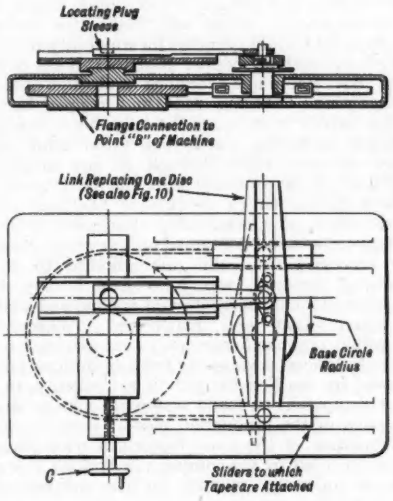

Locating Plug Sleeve
Flange Connection to Point "B" of Machine
Link Replacing One Disc (See also Fig. 10)
Base Circle Radius
C
Sliders to which Tapes are Attached

FIG. 11—*Practical Arrangement of Attachment for Involute Generating*

Applications of Generating Principles

Fig. 13*a* shows diagrammatically a radius r to be ground about a centre x inches west and y inches north of the grinding point (defined by the wheel microscope). The work is related to the grinding position by use of the optical scales, and the final relationship of the grinding

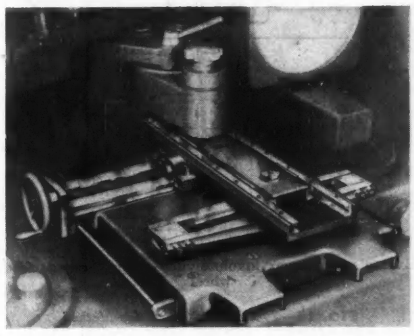


FIG. 12—*Attachment for Involute Grinding in Use*

wheel and the work is shown by Fig. 13*b*. For a radius concave instead of convex the value $x+r$ would be written $x-r$, and the distance R would be written $r-r'$ (where r' is the radius of the wheel edge).

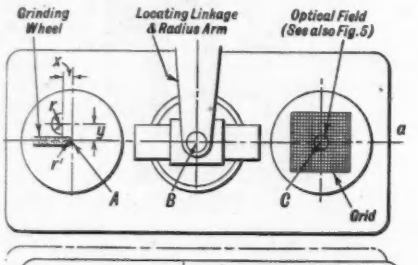
With gyratory methods axis B will rotate about centre B', and axes A and C will rotate about virtual centres A' and C' respectively.

When translatory methods are used, axis B will rotate about centre B' and axes A and C will trace circular paths about virtual centres A' and C' respectively without change in

orientation. In this case r' is additive or subtractive, according to whether r is concave or convex, and allowance must be made for this in setting.

The choice of right-angle or polar co-ordinates is a matter of suitability and either may be used with equal facility.

Fig. 14 shows, diagrammatically, the involute attachment substituted for the radius attachment. Methods of setting conform in principle

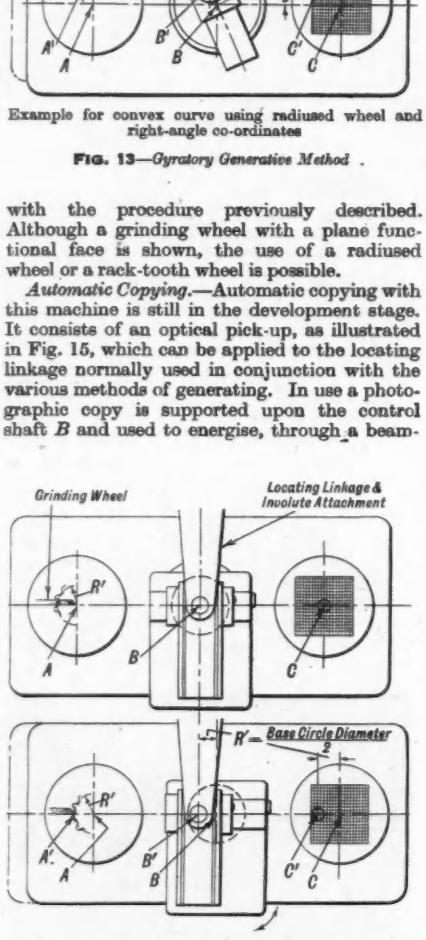


Example for convex curve using radiused wheel and right-angle co-ordinates

FIG. 13—*Gyratory Generative Method*

with the procedure previously described. Although a grinding wheel with a plane functional face is shown, the use of a radiused wheel or a rack-tooth wheel is possible.

Automatic Copying.—Automatic copying with this machine is still in the development stage. It consists of an optical pick-up, as illustrated in Fig. 15, which can be applied to the locating linkage normally used in conjunction with the various methods of generating. In use a photographic copy is supported upon the control shaft B and used to energise, through a beam-



Example for convex involute curve using plane surface wheel

FIG. 14—*Translatory Generative Method*

splitting device, two photo-electric cells, one each for the x and y components of the form to be followed. The amplified x and y currents are then used to control electric motors on the x and y slides of the machine.

The great advantage of this method of control is that, when dealing with a progressively changing cross section, a considerable number of individual sections can be drawn out and photographed, each section being indexed into the optical field as the grinding wheel finishes each sweep across the work. Fig. 15 shows a turbine blade treated in this way.

Another advantage is that a duplicate picture can be projected on to the viewing screen to form a continuous check. The arrangement is designed to permit overriding manual control.

Copy Grinding.—Copy grinding is a perfectly straightforward operation; a full-size photographic copy is projected on to the viewing screen simultaneously with a suitable wheel form, and the two outlines are maintained

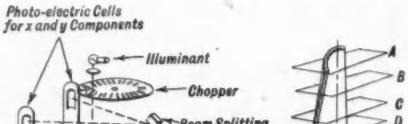


FIG. 15.—*Optical Pick-Up for Automatic Copying*

tangential to one another as the carriages are traversed under the control of the two handwheels.

When the copy is a photographic transparency, which is usual, generative and copying methods may be combined—this is particularly useful when some part of the required form is beyond the scope of generative methods.

Non-Ferrous Tube Production in South Africa

A COMPLETE range of copper and brass tubing made from South African raw materials is now being produced in the recently established factory of the Non-Ferrous Tube Company (Pty.), Ltd., at the New Era Industrial Township, Springs, Transvaal. This company with an authorised capital of £500,000, is associated with a group of companies in Britain, the principals of which are the Wednesbury Tube Company, Ltd., Bilston, Staffordshire.

Included in the range of products manufactured by the New Era factory are copper tubes for hot and cold water services; copper tubes for mining and industrial use; brass tubes of various alloys; sugar and locomotive boiler tubes; and pump cylinders for windmill pumps; high-conductivity copper busbars; brass bars for hot stampings, forgings and high-speed machining; welding rods and copper bars. This factory is probably the only one in South Africa producing non-ferrous tubes from the raw material right through to the finished article. It is probably also the only manufacturer in the Union at present handling the production of special alloy condenser tubes. Designed as a self-contained unit in which metal is processed from the raw material to the finished product, the New Era factory is situated on a 13-acre site and is equipped with modern plant and machinery. Wherever possible, the machinery now in use was built by South African engineering firms to designs prepared by the Non-Ferrous Tube Company, and the equipment so made represents a large proportion of the production plant. Prior to the completion of the main factory, a pilot plant was operated by the company in Springs over a period of many months for the purpose of training local labour.

The copper is derived from ore mined in the Transvaal, and transported from the mine to the company's private railway siding in ingot form. The ingots are then refined in the company's own foundry and cast into billets in copper and various alloys. All other raw materials required are obtained from sources in Africa, principally Rhodesia.

French Engineering News

(From our French Correspondent)

Construction work at various Moroccan ports is now under way. At Casablanca 200m of new quay will be opened shortly, and by 1952 1000m of new quays will be ready. At Mazagan a jetty is being reconstructed and a silo with 30,000 quintals capacity is also being built at this port. The Port of Agadir is also to be greatly extended. This project includes the construction of a 120m to 140m quay, the extension of pierheads, the construction of a second quay 167m long, and the building of a large fish market.

* * *

The "Champagne," a new 16,500-ton tanker, ordered by the Ministry of Merchant Marine, was recently launched. The tanker was built by the Ateliers et Chantiers de la Seine-Maritime. It is 165m long and 21m wide, with a tank capacity of 22,720 cubic metres. It draws 9m of water and has a speed of 13 knots and is equipped with a Burmeister and Wain 6000 h.p. eight-cylinder engine.

* * *

Four months after receiving aid from the Economic Co-operation Administration, a new factory of the Compagnie Internationale de Machines Agricoles at St. Didier, is now turning out French tractors. This company is a subsidiary of the International Harvester Company of America, and at the moment is working with parts received from the United States. Production by 1954 should reach 7500 tractors, using French parts. In 1951 the plant will turn out some 750 tractors.

* * *

It is now likely that there will be no machine tool section at next year's Paris Fair. Instead, the machine tool industry will hold a fair of its own in September. Foreign manufacturers will be invited to exhibit at the Fair, but not under the name of the importing agent, each foreign exhibitor having a stand of his own. Manufacturers who wish to show at the Paris Fair may still do so, of course, but the section will be greatly reduced next year.

* * *

The electricity position in France continues to be very favourable and it is unlikely that the winter will see serious restrictions. Hydraulic production has reached a weekly total of 224 million kWh, and thermal production 402 million kWh, giving total production of 626 million kWh. Net imports amounted to 5 million kWh. Hydro-electric storage reservoirs were about 76 per cent full in October. Electricity production in France in 1949 was 35·7 per cent higher than in 1939. In a report recently published it is stated that France is fourth in the list of global production, following the United States, Britain and Canada.

* * *

A prefabricated bridge has recently been erected at Oubanghui in Equatorial Africa. The bridge comprises six sections, 10·16m long and weighing 5 tons, and was erected in one and a half hours. The girders of the bridge were prefabricated at Bangui and brought to the Goumba River by road, and then placed in position with a crane.

* * *

The Saut de Mouton (flyover crossing) between Dijon and Perrigny is the longest construction of its kind in France. It was built in readiness for the electrification of the Paris-Lyon line, and is about 1200 yards long and can carry trains travelling at 140km per hour. The flyover track is carried on a 7m high embankment, and on a number of reinforced concrete piers spaced 14m apart and supported on reinforced concrete piles.

* * *

A successful series of trials, to test the possibility of obtaining gas from a seam of anthracite coal at Djerada have recently been completed. The problem has been studied since 1946, the first attempts at extraction being made in 1949. Installation of plant and some three years' preliminary work have cost about 50 million francs. The trials were carried out on a very thin vertical seam which could not normally be worked commercially.

Industrial and Labour Notes

Engineering Wages]

In a written Parliamentary reply, which he made at the end of last week, the Minister of Labour, Mr. Isaacs, put on record the steps which have been taken since he was asked to intervene in the outstanding claim for a wage increase in the engineering industry. The Minister stated that the matter was reported to him by the Confederation of Shipbuilding and Engineering Unions on July 17th. Following some informal conversations, officers of the Ministry of Labour met representatives of the Engineering and Allied Employers' National Federation and of the Confederation of Shipbuilding and Engineering Unions later in that month to consider the situation. At that meeting, it was agreed to appoint a small informal committee of representatives of each side to see whether a basis could be found for a full resumption of negotiations.

The committee, the reply continued, met twice and the result was a basis acceptable to both sides for a resumption of negotiations. Formal conferences between the parties followed on September 20th and October 2nd, but agreement could not be reached on the Confederation's claim. On October 19th the Confederation of Shipbuilding and Engineering Unions requested that the claim should be referred to the National Arbitration Tribunal, and that reference was made on October 21st. The hearing by the Tribunal took place on November 6th and its award was now awaited.

A National Wages Policy

In the November issue of its monthly journal, *Labour*, the Trades Union Congress has made some observations on the demand for a national wages policy. In some quarters, the T.U.C. says, the demand has been for a national wage authority, the responsibility of which would be to supervise all wage decisions, whether awarded by arbitration or negotiated jointly by representatives of workers and employers. Since supervision would be useless without control, it is suggested that what the sponsors of the idea really mean is that no wage advance would be payable without the approval of some central body. But, the T.U.C. comments, a precise definition of how that central body should be constituted is not always forthcoming.

Advocates of one elaborate proposal the T.U.C. continues, envisage a central authority with independent members—perhaps advised by panels of nominees of unions and employers' organisations—through whose sieve all wage agreements would pass before becoming operative. The T.U.C. claims, however, that such an authority would have a formidable task. To do its job thoroughly, it would need at least a complete knowledge of the components of the national income, an up-to-date cost-of-living index, and a job evaluation survey covering thousands of occupations. Much of that information, it is asserted, simply does not exist at present, nor could it be assembled except over a period of years and by a large staff of statistical and other experts. Moreover, the T.U.C. adds, the Government could not be kept out of the picture. However independent a central commission sought to be, it would inevitably turn to the Government for guidance on such problems as the national importance of one industry relative to another and of all wage earners in relation to other sections of the community.

The T.U.C. view is that the establishment of a central wage authority would amount to making compulsory arbitration a permanent feature of Britain's industrial life. It agrees, however, that a strong case can be made for an overhaul of the wages structure in some industries and for a fresh look at differentials and a new approach to incentive payments. The negotiating machinery, the article concludes, has proved adaptable enough to cope with problems equally as difficult, and it would be little short of a national disaster to supersede it completely by an imposed new system devised outside industry, and "unable to draw upon the loyalty of freely enrolled trade union members to its decisions."

Ministry of Fuel's "Statistical Digest"

Last Saturday, November 11th, the Ministry of Fuel and Power published its "Statistical Digest" for the years 1948 and 1949. It is a document of considerable size and undoubtedly constitutes a comprehensive collection of British fuel and power statistics. It deals, for example, with all aspects of coal production and distribution, with electricity and gas, and with manufactured fuels. In addition, there are some useful tables relating to the refining, supply and consumption of petroleum. New material published in the "Digest" includes information about wages, salaries, capital expenditure and value of output in each of this country's fuel and power industries.

The price of the "Digest," which may be obtained from H.M. Stationery Office, is 7s. 6d.

Colliery Manpower

The latest figure for colliery manpower to be issued by the Ministry of Fuel and Power is a total of 686,800 on colliery books, of whom 284,300 are face workers. At this time last year there were 709,100 on colliery books, of whom 293,800 were working at the face.

The Minister of Fuel and Power, Mr. Noel-Baker, was questioned on the matter in Parliament on Monday last, and in his reply stated that it was of "urgent importance" that the present decline in manpower in the mines should be checked and that the number of miners should, if possible, also be increased. This year, the Minister said, the National Coal Board had recruited more newcomers to the industry than it did a year ago, but, in conditions of full employment, more men had left the mines for other work, and since July some thousands of miners had joined the armed Forces.

Mr. Noel-Baker added that the Coal Board and the Government viewed with particular concern the fall in manpower at the coal face. They were now considering what steps could be taken to check the present wastage, to induce more ex-miners to return to the pits and to improve general recruitment. The Minister said also that he was asking the National Union of Mineworkers to consider how the nation's urgent need for more coal during the winter months could most effectively be brought home to every miner.

Zinc Allocations

The Government's recent decision to restrict zinc consumers in the United Kingdom to not more than nine-tenths of their average monthly consumption in 1949 continues to cause a great deal of concern in several industries. On Monday last, for instance, the Minister of Supply, Mr. Strauss, was asked in Parliament how far it was intended to make the present zinc allocation retrospective, and how it was proposed to deal with the requirements of the motor-car industry for December.

In his reply, Mr. Strauss said that the restrictions on the supply of zinc applied from October 1st, the measure of restriction having become necessary in order to preserve the country's stocks at a reasonable level. He appreciated, however, that to relate allocation to usage in 1949 without taking into account developments since then, or the relative importance to the economy of the different uses of zinc, could only be a stop-gap measure. Some temporary adjustments had been made for November to meet urgent cases and the matter was under "immediate review."

Management Accounting

A British specialist team visited the U.S.A. in the earlier part of this year, on the recommendation of the Anglo-American Council on Productivity, to study methods of management accounting. Its terms of reference were to find out what accounting, costing and statistical information was provided for American management at different levels, by what methods it was obtained, and how it was used. This week, the report of the team has been published, and is certainly one which will prove of importance to all industrialists who are concerned with the stimulation of productivity in this country.

The report defines management accountancy as the presentation of accounting information in such a way as to assist management in the creation of policy in the day-to-day operation of an undertaking. The technique of accountancy, it claims, is of extreme importance as it works in the most nearly universal medium available for the expression of facts, "so that facts of great diversity can be presented in the same picture." The findings of the team emphasise the significant part played in America by efficient management. The effectiveness of American management and accounting, the report says, rests not on technical superiority, but on the thorough application of techniques which are as well known in Britain as they are in the U.S.A. The team believes that competition has had a considerable effect on American management's attitude to management accounting, and therefore recommends that an investigation should be made by an independent commission into the extent of price agreements, quotas and restrictive practices, and that consideration should be given to the effect they are having on technical development and on the cost of production in this country. A further suggestion made is to consider whether such agreements and quotas should only be allowed by express Parliamentary sanction. As the mainspring of all its action, the report observes, American management has the well-founded belief that unit costs must be reduced "each day and every day, week in and week out, year in and year out."

In its recommendations, the team advocates that management should make the fullest use of budgeting and forecasting, should utilise standards of performance and accounting technique to permit decentralisation of responsibility, and should bring industrial accountants into consultation in the early stages of formulating policy. Accountants, on their part, it is suggested, should constantly consider what information is required by management at different levels, and should acquaint themselves with the problems of management and the technical processes involved. Recommendations of more general interest are that companies should publish fuller information in their annual reports; that there should be closer collaboration between industry, Government departments, trade associations and other agencies interested in industrial statistics; that Government and industry should consider the problems of redundancy likely to arise owing to the anticipated advance of British industry, and that there should be "active interest" on the part of management in the extension of institutes and colleges teaching business administration at all levels.

The report may be obtained from the Anglo-American Council on Productivity, 21, Tothill Street, London, S.W.1, price 2s.

Personal and Business

SULZER BROS. (LONDON), Ltd., announces that Mr. G. W. Heslett, chief estimating engineer, has been appointed manager of the pump department.

THE NATIONAL ASSOCIATION OF MARINE ENGINE-BUILDERS states that Sir Philip Johnson and Mr. T. A. Crowe have been elected chairman and vice-chairman, respectively.

ROCKWELL MACHINE TOOL COMPANY, Ltd., Welsh Harp, Edgware Road, London, N.W.2, has been appointed sole agent in this country for "Jung" internal grinding machines.

MR. A. G. CLARK, Mr. J. F. Mallabar, Mr. B. G. W. Attwood, Mr. E. J. Earnshaw and Mr. T. White Wilson have been appointed directors of Plessey International, Ltd., Ilford, Essex.

PHILIPS ELECTRICAL, Ltd., announces the opening of the following new branches and showrooms: 40, Little Lever Street, Manchester, 1; 6–10, Leeds Street, Liverpool, 3; 11–13, Penarth Road, Cardiff; 27, Landport Terrace, Southsea.

METROPOLITAN-VICKERS ELECTRICAL COMPANY, Ltd., announces the following appointments: Mr. F. B. Holt, assistant chief engineer (industrial); Mr. D. R. Love, assistant chief engineer (mining), and Mr. W. J. Price, assistant chief engineer (power).

MR. G. W. ALEXANDER, B.Sc., A.M.I.E.E., has been appointed chief engineer of Powell Duffryn Technical Services, Ltd., 19, Berkeley Street, London, W.1. Mr. Ivor Williams, who has been acting as chief engineer of the company, has now become chief consulting engineer.

MR. S. FERGUSON, M.I.E.E., founder of Cooke and Ferguson, Ltd., Openshaw, Manchester, has resigned from the chairmanship of the board in order to have more time to devote to his other interests. He will continue to serve as a director. Mr. T. H. Windibank, M.I.E.E., director of Crompton Parkinson, Ltd., has been appointed a director and chairman of the board of Cooke and Ferguson, Ltd.

DARLING AND SELLERS, Ltd., machine tool makers, Airedale Works, Keighley, originally established in the year 1850, has been taken over jointly by D. Mitchell and Co., Ltd., Parson Street, Keighley, and Rushworth and Co., Sowerby Bridge. The newly-appointed directors are Mr. P. Leslie Crabtree, Mr. C. Donald Rushworth, Mr. John W. Rushworth and Mr. Sidney Wilson. The London office of Darling and Sellers, Ltd., through which all export orders will be transacted, is at 44–45, Tower Hill, E.C.3.

Launches and Trial Trips

ORDIA, cargo liner; built by William Denny and Brothers, Ltd., for the British India Steam Navigation Company, Ltd.; length 420ft, breadth 57ft 3in, depth 38ft., deadweight 9000 tons; reciprocating machinery with Bauer-Wach turbines, oil-fired boilers. Trial, August 25th.

DROFIR, steam trawler; built by Hall Russell and Co., Ltd., for the Icelandic Government; length 183ft 6in, breadth 30ft, depth 16ft; triple-expansion engine, 1000 i.h.p. Launch, August 28th.

ATHELBEACH, motor tanker; built by R. and W. Hawthorn, Leslie and Co., Ltd., for the Athel Line, Ltd.; length 459ft, breadth 61ft, depth 31ft, deadweight 10,000 tons; Hawthorn-Doxford oil engine, four cylinders, 670mm diameter by 2320mm combined stroke, 4450 b.h.p. at 112 r.p.m. Trials, August 29th and 30th.

INTWARA, motor cargo and passenger ship; built by Henry Robb, Ltd., for the British India Steam Navigation Company, Ltd.; length 280ft, breadth 46ft, depth 19ft 6in, deadweight 1800 tons; twin Kincaid-Polar diesel engines, five cylinders each, 4000 b.h.p. total at 250 r.p.m. Launch, August 29th.

ALIOTH, motor cargo liner; built by the Burntisland Shipbuilding Company, Ltd., for Van Nievelt, Goudriaan and Co.'s Stoomvaart Maatschappij N.V., Rotterdam; length between perpendiculars 408ft 6in, breadth 57ft, depth moulded to shelter deck 37ft 6in, deadweight 8350 tons; Doxford oil engine, four cylinders, 600mm diameter by 2320mm combined stroke, 3300 b.h.p. Trial, September.

LONDON PRIDE, motor tanker; built by the Furness Shipbuilding Company, Ltd., for London and Overseas Freighters, Ltd.; length between perpendiculars 496ft, breadth moulded 67ft 6in, depth moulded 36ft 5in, deadweight 16,325 tons on 29ft 1½in draught; North-Eastern Marine-Doxford opposed-piston, two-stroke, airless-injection engine five cylinders, 670mm diameter by 2320mm combined stroke, 5500 b.h.p. at 114 r.p.m., two Scotch boilers, steam auxiliaries. Trial, September 25th.

Notes and Memoranda

Rail and Road

BRITISH RAILWAYS APPOINTMENT.—The Railway Executive has announced that, with the concurrence of the British Transport Commission, Mr. S. B. Warder, M.I.Mech.E., M.I.E.E., Mechanical and Electrical Engineer, Southern Region, has been appointed Chief Officer (Electrical Engineering), Railway Executive Headquarters, in succession to Mr. C. M. Cock.

INTERNATIONAL ROAD CONGRESS IN 1951.—The Permanent International Association of Road Congresses has arranged a tentative programme for the congress which will take place in Lisbon in September, 1951. It will be the ninth international road congress and is expected to be in session from September 24th to October 8th. A number of interesting technical excursions have been organised and the technical questions to be studied, which are given below, cover a wide range. Question I is concerned with the progress made since the Congress at the Hague in 1938; (a) in the use of cement and special surfacing materials; (b) in the use of plastic binders. Question 2 covers road subgrades and Question 3 factors in road design and the study of traffic. Question 4 is entitled "Economic Justification of Roads"; Question 5 is about construction and maintenance of roads and Question 6 concerns the development of highways in thinly populated countries. There will also be a detailed paper on "Plant Used in Connection with the Construction and Maintenance of Roads."

Air and Water

GAS TURBINE FOR OIL TANKER.—The Shell Petroleum Company, Ltd., announces that it expects to install shortly a marine gas turbine in the oil tanker "Auris." When this vessel was built two years ago provision was made for fitting and testing a merchant ship unit. The existing machinery consists of four Hawthorn-Sulzer eight-cylinder, single-acting, airless-injection, supercharged oil engines, each developing 1105 b.h.p., which are direct coupled to British Thomson-Houston double-unit, 830kW alternators. The gas turbine, of 1200 h.p., will be installed in the place of one of the oil engines as a prototype for a unit of 6500 h.p.

I.N.A. AWARDS.—The Council of the Institution of Naval Architects has made the following awards: Froude Research Scholarship in Naval Architecture (1950), £500 per annum for two years, to Mr. R. L. Townsin, B.Sc., of King's College, Newcastle-on-Tyne; Sir William White Post Graduate Scholarship in Naval Architecture (1948), £150 per annum, to Mr. David I. Moor, B.Sc., of William Denny and Bros., Ltd., Dumbarton, for one further year; Parsons Scholarship in Marine Engineering (1950), to Mr. G. M. Jordan, of Alfred Holt and Co., Liverpool, £175 per annum for three years, at Liverpool University; and Yarrow Scholarship in Marine Engineering (1950), to Mr. A. W. Bolwell, of Yarrow and Co., Ltd., Scotstoun, Glasgow, £175 per annum for four years at Glasgow University.

Miscellanea

KONGWA WORKING PARTY.—The Board of the Overseas Food Corporation have accepted the main essentials of the report of the Kongwa working party and the arable agriculture recommendations will be adopted for next planting season.

EXPORT OF ALUMINIUM.—The Board of Trade announced on July 5th that individual export licences would be required for the export of aluminium or aluminium alloy goods valued at less than £150 per ton. It has now been stated that all such goods valued at less than £180 per ton will require individual licences.

SHELL OMALA OILS.—A range of Shell Omala oils has recently been introduced for use in enclosed gears, where severe sliding and pressure conditions call for chemically active lubricants. The oils contain additives, which at the high contact surface temperatures form a protective film and prevent metal to metal contact of the gear teeth.

MODEL SAFETY RULES FOR CHEMICAL WORKS.—The Association of British Chemical Manufacturers has issued Supplement No. 1 to its "Model Safety Rules for Use in Chemical Works," Part I, the third edition of which was published in 1947. This Supplement contains the changes made necessary by the Factories Act, 1948, together with a few minor changes and additions as the result of experience in use. The amendments are printed on separate gummed slips to allow of insertion in the blank pages provided for that purpose in the existing Rules. Copies of the Supplement are being sent gratis to all known purchasers of the original edition of the rules. Copies of the third edition of Part I of the rules, including a copy of this first Supplement, are still available from the Association Office at 166, Piccadilly, London, W.1, at the nominal price of 7s. 6d.

"ARALDITE" ADHESIVES.—Aero Research, Ltd., of Duxford, Cambridge, announces that the range of "Araldite" adhesives, which has hitherto been imported from Switzerland, is now being manufactured at the company's works. These adhesives are supplied in various forms for bonding metals, porcelain, mica, &c., and as fillers, coatings and casting resins.

COAL IN NORTHERN RHODESIA.—A report received from Northern Rhodesia indicates that a valuable coalfield may exist in the territory. The Colonial Office says that preliminary drilling by a Government-sponsored syndicate has taken place in the Gwembe Valley. Coal beds up to 4½ft thick in the Congola area have been discovered, and samples have been sent to Johannesburg for analysis. The site of the borehole—completed at a depth of 624ft—where the first strike was made, is 28 miles by road from the Chisekesi Siding, the nearest point on the railway.

BRITISH HYDRO-ELECTRIC PLANT FOR KIEWA, AUSTRALIA.—An order has been placed for the main generating units of the third power station of the Kiewa hydro-electric scheme of the Victoria State Electricity Commission. Two 17,778kVA water-wheel generators are to be built by the Metropolitan-Vickers Electrical Company, Ltd., which has already four similar machines under construction for the same scheme. The generators will be vertical spindle sets and will run at the high speed of 600 r.p.m. They will generate normally at 11·5kV, with a continuous maximum rating of 12·1kV.

T. H. AND J. DANIELS, LTD., APPRENTICESHIP SCHEME.—An interesting illustrated brochure, giving full details of its apprenticeship scheme, has just been issued by T. H. and J. Daniels, Ltd., of Lighthill Ironworks, Stroud, Glos. Two separate schemes for craft and engineering apprentices are laid down, the first for training boys as skilled tradesmen and the second for training boys showing particular aptitude, or with higher educational qualifications, to the production, design or administrative sides of engineering. A third training scheme is provided for boys wishing to follow secretarial or accounts careers. All classes of apprentices at the firm attend Stroud Technical School one day and one or two evenings each week and a scheme has been introduced for exchanging apprentices with other works during the latter part of their training in order to broaden their experience.

LONDON TRANSPORT TUBE EXTENSION PLANS CANCELLED.—A review was recently made by the London Transport Executive of the schemes to develop and extend the Northern Line, which remain outstanding from the 1935/40 new works programme. As a result of this review, it was decided that, in view of the introduction of the Green Belt proposals since the original plan was made and the consequent restriction upon development, there was now no justification for extending the line beyond Edgware as far as Bushey Heath, and this part of the scheme will be abandoned or at least curtailed. Extension from Edgware as far as Brockley Hill and also electrification beyond Mill Hill East either to Edgware or to Mill Hill (The Hale) only, may be contemplated later, when the area to be retained as a Green Belt has been more precisely defined and potential development and traffic requirements can be assessed.

TURNER AND NEWALL, LTD.—The firm of Turner and Newall, Ltd., was formed in 1920 for the purpose of bringing together under a single ownership four family concerns which had been long established in the manufacture of asbestos and magnesia products. To mark the thirtieth anniversary of the firm, an interesting brochure has been published, describing the history and growth of the organisation. This brochure gives full details of the constitution and background of the four original companies—Turner Brothers Asbestos Company, Ltd.; the Washington Chemical Company, Ltd.; Newalls Insulation Company, Ltd., and J. W. Roberts, Ltd., and other companies now part of the organisation. These other companies include Ferodo, Ltd., and Bell's United Asbestos Company, Ltd., in this country; Keasbey and Mattison Company in the United States, and Turner and Newall (Canada), Ltd., in Canada, as well as other concerns in Africa and India, all of which are dealt with in some detail in the publication.

British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.

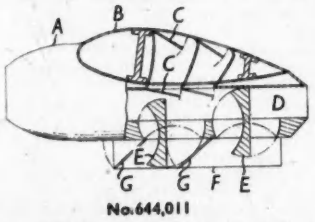
Copies of specifications may be obtained at the Patents Office Sales Branch, 25, Southampton Buildings, Chancery Lane, W.C.2, 2s. each.

AERONAUTICAL ENGINEERING

644,011 August 27, 1946.—Improvements in Jet Propulsion and Control Means Therefor, Aubrey Douglas, of Saltford Farm, Saltford, Somerset.

This invention is particularly concerned with jet-propelled aircraft and a method and means for controlling the propulsive effort created by the jet.

In the accompanying drawing, a jet propulsion unit *A* is mounted below and forward of the wing *B* which is provided with hinged flaps *C* for directing the boundary layer to obtain thrust augmentation through ducts in the wing which communicate with the nozzle outlet or jet tube *D*. The flaps are adjustable whereby the thrust augmentation effect obtained may be controlled. The jet tube is, in addition, provided with rotatable diversion baffles *E*, which, together with side doors *F* and members *G*, form a temporary efflux duct for the gases so



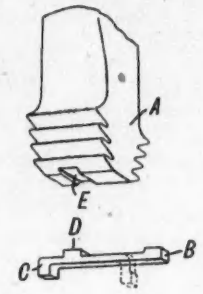
No. 644,011

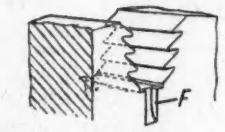
diverted. The flaps *C* may be arranged as non-return flaps, or equivalent means may be fitted to prevent beating back of the flame to the wing surface from the efflux tube in case of blow back. Thrust augmentation, such as obtained, for example, by the arrangement illustrated, results from the sucking-in of an auxiliary airflow through the inclined intakes, thereby producing an injector effect, and it may be employed throughout any part of the length of the jet tube and may be combined with any valve or valves or ducting. An additional advantage of this arrangement is that the taking in of additional air into the jet tube through the intake of the ejector may, in certain circumstances, increase the thrust of the jet engine. —*October* 4, 1950.

TURBINES

643,914. March 8, 1948.—Improvements in and relating to Turbine or like Blade-Securing Means, Joseph Stanley Hall, "Brentwood," Mornington Road, Sale; John Garland, 126, Bamford Street, Chadderton, Oldham, and Metropolitan-Vickers Electrical Company, Ltd., 1–3, St. Paul's Churchyard, London, E.C.4.

In the case of single-disc turbine wheels, it has been the practice to lock the axially inserted blades in their operative position by peening over edge portions of the blade root and disc at both sides of the turbine disc. One disadvantage of peening, however, is that the root of the turbine blade is liable to become damaged when the blade is removed for repair or replacement. Moreover, if the turbine consists of several stages each having one or more closely spaced discs, peening over the root portions between the discs is rendered difficult owing to the lack of available space in which to bring a suitable peening-over tool to bear. According to this invention means for locking a turbine blade in its operative position on a turbine disc comprises a detachable key member having a locating projection or boss arranged to fit into a complementary recess formed in the blade root and an extended portion at each end of the key adapted to be bent over to form locking shoulders against the side face of the disc. An embodiment of the invention as applied to a single-stage axial-flow turbine rotor having axially inserted blades with serrated roots is shown in the accompanying drawing, giving fragmentary perspective views of the blade root, the key member, and the root cavity in the rotor disc respectively. For securing the blade root *A* within its cavity in the rotor disc, a key of rectangular cross section and having a deformable portion *B* and a projecting shoulder *C* is provided with an upstanding rectangular boss *D*. The position of the boss is preferably off-centre, as shown, so as to ensure correct fitting. The key is made sufficiently long to ensure that in its assembled position when the shoulder *C* engages one side face of the disc the end *B* will overhang the other side face, and when bent over will engage the face. In the under surface of the blade root is provided a parallel-walled recess or slot *E* in which the boss *D* is engaged to locate the blade with respect to its shoulder. The slot is also machined off-centre by an amount similar to that by which the boss is off-centre on the key to ensure that when mounting the blade on the rotor disc the key can only be assembled with the shouldered end,





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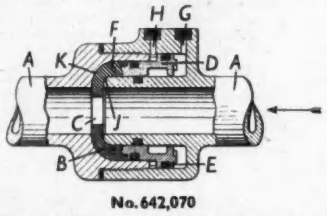
adjacent the pressure side of the turbine disc. In order that windage losses during rotation will not be increased, the side faces of the rotor disc are provided with suitable recesses to receive the key shoulder and end portion. The recess *F* is formed radially deeper to extend beyond the extremity of the key end so that it can be straightened by a suitably ended levering tool when the blade has to be removed from the disc.—*September* 27, 1950.

MISCELLANEOUS

642,070 August 10, 1948.—Improvements relating to Valves for Fluids, The Minister of Supply, of Adelphi, Strand, London, W.C.2 (*Inventor, William George Hill*).

This invention relates to valves for controlling the flow of gases, liquids or semi-fluid or viscous materials such as grease. According to the invention, such a valve comprises a thimble or dome-shaped member of rubber or similar material which has an opening in its end and is so constrained between guiding surfaces that by pushing or pulling on the free end of the member the opening can be enlarged or reduced so as to control the flow of a fluid passing through it. The invention may, for example, be applied to the nozzle of a fire hose to provide a means of varying the size of the jet, or it may be incorporated in a pipe-line for the purpose of either controlling or metering the fluid passing through the line. Referring to the drawing, *A*



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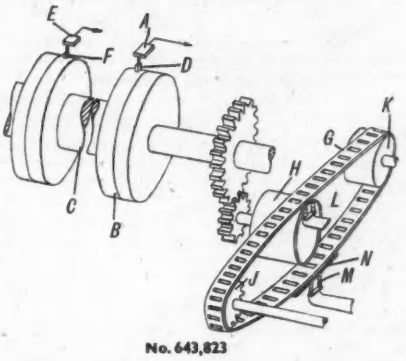
indicates the pipe-line through which fluid is to be forced in the direction of the arrow indicated, and *B* indicates the thimble or dome-shaped member of rubber. It has a circular coaxial opening in its end as indicated at *C*. The valve member *B* is made of synthetic rubber having a hardness of from 55 to 65 Shore. It is moulded in the form shown. That is to say, the member is shown in the drawing in the form in which it comes from the mould, so that in this condition it is unstressed and has an opening of the size indicated. The free end of the valve member is bonded to the end face of a cylindrical piston *D*. The other end of the cylindrical piston has an enlarged portion *E*. The valve member is moulded on to the end of the cylinder in such a way that rubber passes through a series of radial holes drilled in a skirt-like extension *F* of the piston, and the end of the valve member is also stepped over the piston as shown in order to assist in producing an effective bonding. The piston is arranged to slide in an appropriately shaped cylinder formed between two enlargements on the ends of the two parts of the pipe-line. A channel *G* is provided whereby pressure fluid can be admitted so that it acts on the end face of the piston remote from that to which the valve member is bonded. A second channel *H* is provided to admit pressure fluid to act on the other face of the extension *E* on the piston. Admission of fluid through one or the other of these channels acts to push the piston to left or right. The piston and the cylinder in which it moves are provided with three annular grooves containing sealing rings as shown. The curved portion of the valve member *B* is received between two correspondingly curved surfaces on the enlarged end portions of the two parts of the pipe-line. These surfaces are indicated in the drawing at *J* and *K*. It has been found that with the construction shown, if pressure fluid is admitted at *G* so as to force the piston to the left, the resulting pressure on the free end of the valve member causes the opening *C* to be reduced in size concentrically; admission of pressure fluid at *H*, which tends to move the piston to the right and consequently pull on the free end of the valve member, causes the opening *C* to be enlarged concentrically. In the construction shown the opening can be enlarged until it is of the same diameter and concentric with the bore of the pipe-line, and it can be reduced until it has a diameter of not much over ¼in. The valve can thus be used to give a continuous control, within limits of the fluid passing through the pipe-line.—*August* 25, 1950.

643,823. May 11, 1948.—Improvements in or relating to Torque-Measuring Devices, Henry George Yates, of The Riding, Riding Mill, Northumberland, and The Parsons and Marine Engineering Turbine Research and Development Association, of Pametrada Research Station, Wallsend, Northumberland.

The general principle of known forms of torque meter involves measurement of the twist in a length of shaft transmitting power. One object of the present invention is to provide improved forms of torque measuring devices by means of which the aggregate of work transmitted by a shaft in a given period of time may be measured or recorded, even if the rate of working is not constant. In one form, as illustrated, the invention is particularly suitable for low speeds of revolution. A stationary contact *A* is situated near the periphery of a flange *B* on the shaft *C*, near the driving end, and is



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adapted to close an electrical circuit when it meets a further contact *D* on the flange. A second similar pair of contacts *E F* is arranged near the other end of the shaft, i.e., near the driven machine. The contacts *A* and *E* are so located that when the shaft is rotating, but transmitting no power, the respective contacts in each pair mutually co-operate. A light endless flexible belt *G* of ferro-magnetic material passes loosely around the periphery of a drum *H*, which rotates with the shaft *C* either driven by gearing, as shown, or directly coupled to it, and also around the periphery of a pair of wheels *J K*, one of which has projecting teeth which engage with corresponding slots provided in the belt. An electromagnet *L* is adapted to hold the belt against the periphery of the drum *H* and a second electromagnet *M* is similarly adapted to hold another portion of the belt against a fixed surface *N*. Electrical connections are provided whereby in the interval between the operation of contacts *A D* and the subsequent operation of contacts *E F* the electromagnet *L* is energised and the second, *M*, is free, whereas during the remainder of each revolution of the shaft the first electromagnet is free and the second energised. By this means the belt is held stationary during most of the revolution and is driven at the peripheral speed of the drum *H* only during the small part of each revolution performed during the interval between the closing of contacts *A D* and the opening of contacts *E F*. The wheel *J* is adapted to drive a counting mechanism which registers the accumulated total of small rotations over any desired period of time. Since the angular movement of the shaft between the operation of the pairs of contacts is proportional to the torque in the shaft, the cumulative total recorded by the counting mechanism in any given period of time will be proportional to the total work transmitted by the shaft during that period of time.—*September* 27, 1950.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Association of Supervising Electrical Engineers

Sat., Nov. 18th.—OXFORD BRANCH: Electricity Board's Demonstration Room, George Street, Oxford, "Radio Interference Suppression," 3 p.m.

Mon., Nov. 20th.—CENTRAL LONDON BRANCH: St. Ermin's Hotel, London, S.W.1, "Electricity in Agriculture," W. Cover, 6.50 p.m.

Tues., Nov. 21st.—Magnet House, Kingsway, London, W.C.2, "Electricity in the Aeronautical Industry," F. E. Bucknell, 6.30 p.m.

Sun., Nov. 26th.—LUTON BRANCH: George Hotel, George Street, Luton, "Television," G. H. Watson, 8 p.m.

Mon., Nov. 27th.—BOURNEMOUTH BRANCH: Grand Hotel, Firvale Road, Bournemouth, "The History of Electric Washing Machines," G. A. Williams, 8.15 p.m.

British Institute of Management

To-day to Sun., Nov. 19th.—Autumn Management Conference, Harrogate.

British Institution of Radio Engineers

Mon., Nov. 20th.—LONDON SECTION: London School of Hygiene and Tropical Medicine, Gower Street, W.C.1, "Ultrasonic Generators for High Powers," P. E. Noltingk, 6.30 p.m.

Illuminating Engineering Society

Thurs., Nov. 23rd.—BRADFORD GROUP: 45/53, Sunbridge Road, Bradford, "Lighting in the Home," M. Wardlaw, 7.30 p.m.

Incorporated Plant Engineers

Tues., Nov. 21st.—GLASGOW BRANCH: Engineering Centre, 351, Sauchiehall Street, Glasgow, "Experiences in the Sale of Heat," G. A. Rooley, 7 p.m.

Thurs., Nov. 23rd.—S. YORKSHIRE BRANCH: Grand Hotel, Sheffield, Film and Lecture, "Metallisation," 7.30 p.m.

Fri., Nov. 24th.—BIRMINGHAM BRANCH: Imperial Hotel, Birmingham, "The Plant Engineer and the Factories Act," R. Bramley-Harker, 7.30 p.m.

Mon., Nov. 27th.—E. AND W. YORKSHIRE BRANCH: The University, Leeds, "Factory Lighting," 7.30 p.m.

Institute of British Foundrymen

Sat., Nov. 18th.—BRISTOL AND WEST OF ENGLAND BRANCH: Grand Hotel, Bristol, "Casting Inspection," H. Williams, 3 p.m.

Wed., Nov. 22nd.—BIRMINGHAM CENTRE: James Watt Memorial Institute, Great Charles Street, Birmingham, "Chill Roll Manufacture," K. H. Wright, 7.15 p.m.——LONDON BRANCH: Waldorf Hotel, Aldwych, W.C.2, Discussion on "Repair and Reclamation of Castings," A. B. Everest and R. W. Ruddle, 7.30 p.m.

Sat., Nov. 25th.—E. MIDLANDS BRANCH: College of Technology and Commerce, The Newarke, Leicester, "Modernising an Iron Foundry," L. W. Bolton and W. D. Ford, 6 p.m.

Institute of Fuel

Thurs., Nov. 23rd.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "The Performance and Efficiency of an 800 lb per square inch Pulverised Fuel-Fired Boiler Plant Over a Period of Twenty Years," J. A. Cooper and L. W. Young, 5.30 p.m.

Institute of Industrial Supervisors

Tues., Nov. 21st.—KIDDERMINSTER SECTION: Carpet Trades, Ltd., Mill Street, Kidderminster, "Time Study," L. J. Piddington, 7.30 p.m.

Thurs., Nov. 23rd.—LEEDS SECTION: Technical College, York, "The Foreman and Personnel Management," E. Klouman, 7.30 p.m.

Fri., Nov. 24th.—CARDIFF SECTION: Park Hotel, Cardiff, Members' Discussion Night, 7 p.m.

Institute of Metals

Tues., Nov. 21st.—S. WALES LOCAL SECTION: University College, Singleton Park, Swansea, "Electrodeposition for Engineering Purposes," A. W. Hothersall, 6.30 p.m.

Fri., Nov. 24th.—SHEFFIELD LOCAL SECTION: Grand Hotel, Sheffield, "Electrodeposition of Silver," F. G. Parker, 6.30 p.m.

Institute of Navigation

To-day, Nov. 17th.—Royal Geographical Society, 1, Kensington Gore, S.W.7, "Surface Navigation in High Latitudes," 5 p.m.

Institute of Refrigeration

Mon., Nov. 20th.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W.1, "Vitreous Enamel as a Finish for Steel," A. Biddulph, 5.30 p.m.

Institution of Civil Engineers

Tues., Nov. 21st.—Great George Street, Westminster, S.W.1, "Nottingham and District Flood Protection Schemes," W. H. Haile and H. Cheetham, 5.30 p.m.

Wed., Nov. 22nd.—MIDLANDS ASSOCIATION: The College, Loughborough, "New Steel Works, Port Talbot, Planning, Design and Construction," W. G. Charter, 7 p.m.

Institution of Electrical Engineers

To-day, Nov. 17th.—N.E. STUDENTS' SECTION: King's College, Newcastle-on-Tyne, "Brazing by Electricity," L. C. Kerr; "Electricity Distribution," A. Jackson, 6.30 p.m.

Mon., Nov. 20th.—N.E. CENTRE, RADIO AND MEASUREMENTS GROUP: Neville Hall, Westgate Road, Newcastle-on-Tyne, "A New Precision A.C. Voltage Stabiliser," G. N. Patchett, 6.15 p.m.——RADIO SECTION: Savoy Place, Victoria Embankment, W.C.2, "The Nervous System as a Communication Network," J. A. V. Bates, 5.30 p.m.

Tues., Nov. 21st.—LONDON STUDENTS' SECTION: Savoy Place, Victoria Embankment, W.C.2, "Servo Mechanisms," P. G. Briggs, 7 p.m.

Wed., Nov. 22nd.—SUPPLY SECTION: Savoy Place, Victoria Embankment, W.C.2, "The Influence of Rectifier Harmonics in a Railway System on the Dielectric Stability of 33kV Cables," S. B. Warder, E. Friedlander and A. N. Arman, 5.30 p.m.

Mon., Nov. 27th.—N.E. CENTRE: Neville Hall, Westgate Road, Newcastle-on-Tyne, "The Control of Hydro-Electric Plant," A. C. H. Frost and W. Brittlebank, 6.15 p.m.

Institution of Engineering Inspection

Wed., Nov. 22nd.—WOLVERHAMPTON BRANCH: Compton Grange, Wolverhampton, "Lubrication Particularly as Applied to I.C. Engines."

Institution of Engineers and Shipbuilders in Scotland

Tues., Nov. 21st.—39, Elmbank Crescent, Glasgow, "Design and Development Problems in Gas Turbine Engineering," J. F. Shannon, 6.30 p.m.

Institution of Mechanical Engineers

To-day, Nov. 17th.—Storey's Gate, St. James's Park, S.W.1, "The Supercharging of Internal Combustion Engines," Sir Harry Ricardo, 5.30 p.m.

Sat., Nov. 18th.—MIDLAND BRANCH, GRADUATES' SECTION: Visit to Erdington Works of Fisher and Ludlow, 10 a.m.——YORKSHIRE BRANCH, GRADUATES' SECTION: The University, Leeds, "Our Institution and its Work," A. Roebuck, 2.30 p.m.

Mon., Nov. 20th.—MIDLAND BRANCH, GRADUATES' SECTION: James Watt Memorial Institute, Great Charles Street, Birmingham, "Measurement of Torque in Rotating Systems," N. S. Wells, 7 p.m.——SCOTTISH BRANCH: Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, "Significant Contributions of the Diesel Research Laboratory," C. G. A. Rosen, 7.30 p.m.

Wed., Nov. 22nd.—N.W. BRANCH: College of Technology, Manchester, "Significant Contributions of the Diesel Research Laboratory," C. G. A. Rosen, 6.45 p.m.——YORKSHIRE BRANCH, GRADUATES' SECTION: Visit to Walker and Hall, Ltd., Sheffield, 2.30 p.m.

Thurs., Nov. 23rd.—N.W. BRANCH: Engineers Club, Albert Square, Manchester, Three Short Papers, 6.45 p.m.——SCOTTISH BRANCH, GRADUATES' SECTION: Visit to Albion Motors, Ltd., Scotstoun, 7 p.m.

Fri., Nov. 24th.—Storey's Gate, St. James's Park, S.W.1, "The Standardisation of Steam Turbo-Generating Plant," I. V. Robinson, 5.30 p.m.

Institution of Post Office Electrical Engineers

Wed., Nov. 22nd.—Waterloo Bridge House, London, S.E.1, "Wage Incentive Systems," W. Hawking, 5 p.m.

Institution of Production Engineers

To-day, Nov. 17th.—E. COUNTIES SECTION: Public Library, Ipswich, "Mechanical Handling," W. J. T. Dimmock, 7.30 p.m.

Mon., Nov. 20th.—DERBY SUB-SECTION: School of Art, Green Lane, Derby, "Glass and the Engineer," A. J. Holland, 7 p.m.——N.E. SECTION: Neville Hall, Westgate Road, Newcastle-on-Tyne, "Foremanship," A. P. Young, 7 p.m.——MANCHESTER SECTION: College of Technology, Sackville Street, Manchester, "Production and Inspection of Gears," J. Milwain, 7.15 p.m.

Tues., Nov. 21st.—COVENTRY SECTION: Geisha Cafe, Hertford Street, Coventry, "Production of Castings for Quantity Machining," J. Pardoe, 7.15 p.m.——WESTERN SECTION: The College, Swindon, Wilts., "Mechanical Handling," J. R. Sharp, 6.30 p.m.

Fri., Nov. 24th.—S. WALES AND MONMOUTHSHIRE SECTION: Institute of Engineers, Park Place, Cardiff, "Layout for Batch Production," W. E. Mosse, 6.45 p.m.

Junior Institution of Engineers

To-day, Nov. 17th.—39, Victoria Street, S.W.1, "Rubber in Aircraft," F. M. Panzetta, 6.30 p.m.——SHEFFIELD AND DISTRICT SECTION: Grand Hotel, Sheffield, "Some Notes on the Early Days of the Manufacture of Railway Tyres in Great Britain," George Baker, 7.30 p.m.

Fri., Nov. 24th.—39, Victoria Street, London, S.W.1, Annual General Meeting and Annual Meeting of Contributors to the Benevolent Fund, 6.30 p.m.

Sat., Nov. 25th.—N.W. SECTION: Geographical Society, 16, St. Mary's Parsonage, Manchester, "Training of Foreman," F. Burgess, 2.30 p.m.

Liverpool Metallurgical Society

Wed., Nov. 22nd.—Visit to the Works of Rylands Brothers, Ltd., Warrington, 2.30 p.m.

Manchester Association of Engineers

To-day, Nov. 17th.—Engineers' Club, Albert Square, Manchester, "The Use of Mechanical Stokers and Coal Handling Plant for Industrial Boiler Houses," R. W. F. Guy and J. P. Lauder, 6.45 p.m.

North-East Coast Institution of Engineers and Shipbuilders

To-day, Nov. 17th.—Mining Institute, Newcastle-on-Tyne, "A Preliminary Investigation of the Discrepancies Between the Calculated and Measured Wave-Making of Hull Forms," John R. Shearer, 6.15 p.m.

Royal Aeronautical Society

Thurs., Nov. 23rd.—Institution of Civil Engineers, Great George Street, Westminster, S.W.1, "Rockets and Assisted Take-Off," A. V. Cleaver, 6 p.m.

Sheffield Society of Engineers and Metallurgists

Mon., Nov. 20th.—Royal Victoria Station Hotel, Sheffield, "The Scope and Aims of the Sheffield University Post-Graduate School in Physical Metallurgy," A. G. Quarrell, 6.15 p.m.

Society of Chemical Industry

Tues., Nov. 21st.—Burlington House, Piccadilly, London, W.1, "Some Aspects of Semi-Technical Scale Experimentation in Chemical Industry," R. Holroyd.

Society of Engineers

Fri., Nov. 24th.—17, Victoria Street, London, S.W.1, "Anti-Subsidence Foundations," Thos. J. Bray, 6.30 p.m.

British Standards Institution

All British Standard Specifications can be obtained from the Publications Department of the Institution at 28, *Victoria Street, London, S.W.1.*

SAMPLING AND EXAMINATION OF BITUMINOUS ROAD MIXTURES

No. 598 : 1950. The satisfactory use of the wide range of British Standards dealing with road materials depends on the ability of both manufacturers and users to test these materials for conformity with the requirements of the appropriate standard. This standard, which covers the sampling and testing of asphalt and tarmacadam, has just been revised. The section on the sampling of materials has been extended and now deals with sampling at the factory, sampling the contents of vehicles, sampling heaps of materials and sampling materials after laying; this section includes a schedule of minimum sample quantities. Further experience has shown it to be necessary appreciably to increase the sizes of samples in certain tests: not only the sample selected, but also the quantity used in a given test, e.g., the determination of soluble bitumen. The funnel method of determining soluble binder is retained as the reference method for asphalt and the hot extractor method for tarmacadam. The standard includes methods of examination for specific gravity and voids, soluble binder content, water content, and content of mineral aggregate. It also includes a method for the recovery of soluble bitumen and describes the pat stain test for use as a works method. Price 4s. post free.

MACHINE TAPERS, PART I, SELF-HOLDING TAPERS AND GAUGES FOR SELF-HOLDING TAPERS

No. 1660, Part I : 1950. Work has been in progress for some time on a British Standard for machine tapers, which it is hoped will ultimately provide comprehensive information regarding all types of taper commonly encountered in present-day machine-tool practice. The first part of this Standard, which has now been issued, deals with self-holding tapers and gauges for self-holding tapers. It establishes a simplified series of self-holding tapers by a selection of those sizes from the Metric, Brown and Sharpe and Morse series, which are most commonly in use and which at the same time provide a standard series having approximately uniform increments in sizes.

Dimensions and tolerances are given for three types of shank and their appropriate sockets and it should be noted that whilst the shanks are described as self-holding, they are also, in fact, self-driving, since the tang, where present, is intended for ejection purposes only. Dimensions and tolerances and certain general requirements for several types of plug and ring gauges are included and a recommended method of checking the wear of gauges is given in an appendix.

Shanks and sockets made to this Standard are interchangeable with those made according to existing practice, and it is strongly recommended that one of these Standard tapers be adopted for every new design of tool, in order that the inconvenience and uneconomic production, which have in the past resulted from an unnecessary multiplicity of tapers, may be avoided in the future.

Further parts of the Standard now in course of preparation will relate to tapers with cotter drives, self releasing tapers and large machine tapers. It is also hoped to provide an Appendix to the Standard, listing all available data on non-standard tapers. Price 5s., post free.

KEADBY POWER STATION AUTHORISATION.—The British Electricity Authority has received consent from the Ministry of Fuel and Power for the development, to full capacity, of the new Keadby power station, Lincolnshire. Authorisation is given for the installation of two further 60MW turbo-generator sets (which will bring the total installed capacity of the station up to 360MW when completed) and two boilers, each of an evaporative capacity of 550,000 lb of steam an hour. The first set and boiler of the station, which is now under course of construction, are due for commissioning in 1951, and further units will follow in subsequent years, the station being due for completion by 1955.